TM 4931-515-370

OPERATION AND SERVICE MANUAL

MODEL 437A RF SOURCE CONTROL UNIT

and

MODEL 437ASU RF SOURCE UNIT

WEINSCHEL ENGINEERING CO., INC.
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OPERATION AND SERVICE MANUAL

for

MODEL 437A RF SOURCE CONTROL UNIT

and

MODEL 437ASU RF SOURCE UNIT

January 1980

This Manual Applies to Instruments of Serial Number 0012 and Above

SUPPLEMENTS AND ADDENDUMS CONTAINING CHANGE/ERRATA INFORMATION TO THIS MANUAL ARE LOCATED AT THE REAR OF THIS MANUAL

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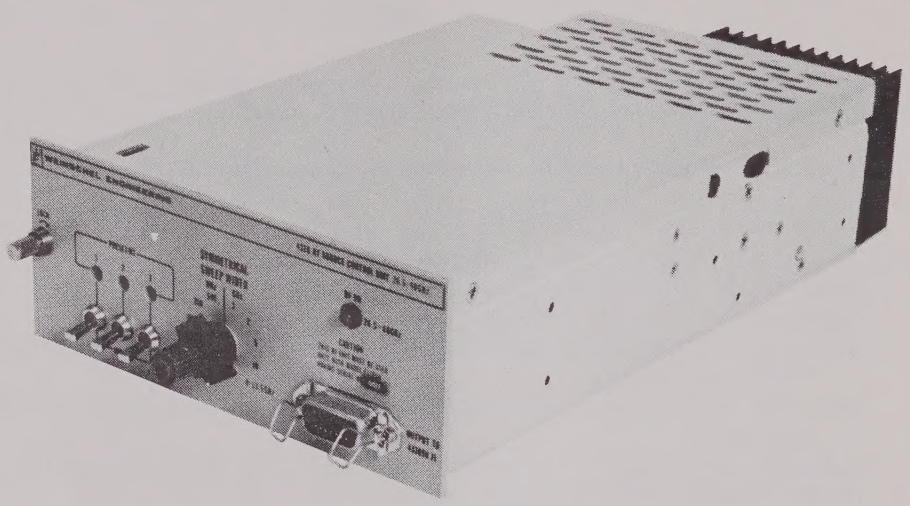
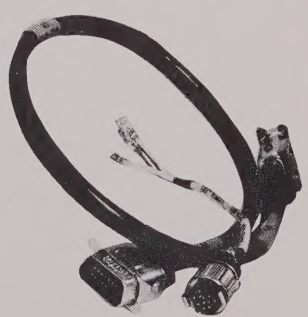


MODEL 437A RF SOURCE CONTROL UNIT

MODEL 437ASU RF SOURCE UNIT



ACCESSORY CABLES

Figure 1-1. Weinschel Engineering Model 437A/437ASU RF Unit (Including Accessories Supplied)

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Weinschel Engineering Model 437A RF Source Control Unit and companion Model 437ASU RF Source Unit (see Figure 1-1) are used in conjunction with the Weinschel Engineering Model 430A and 430B series Sweep Oscillator Mainframes. Frequency coverage of the Model 437A RF Source Control and Model 437ASU RF Source units (thereafter referred to collectively as Model 437A/437ASU RF Unit) is within the k-band (26.5 to 40 GHz). Minimum RF output power is +6 dBm unleveled across the entire frequency range; frequency accuracy is within 1 percent at all sweep speeds.

All references in this manual to the Model 430 pertain to the Model 430A and the Model 430B series Mainframes. Where differences exist between the Model 430A and Model 430B, as related to the Model 437A/437ASU RF Unit, these differences are described, as required, in the appropriate sections of this manual.

The Model 437A/437ASU RF Unit can also be used with the Weinschel Engineering Model 4301A RF Unit Holder and Model 4302B Manual Control Unit. In this configuration the Model 437A/437ASU RF Unit is used with other plug-in RF Units (up to a total of seven other RF Units) to form a manually selectable multi-band system.

1.2 DESCRIPTION

The 437A/437ASU RF Unit is physically a two unit configuration consisting of:

a. A Model 437A, RF Source Control Unit, that serves as a power supply and YIG-tuned oscillator controller.

b. A Model 437ASU, YIG-tuned Gunn diode RF Source Unit, that serves as a controlled RF Source.

A calibrated 26.5 to 40 GHz frequency scale is furnished with each Model 437A/437ASU RF Unit to maintain compatability with the Model 430 Sweep Oscillator. In addition, each Model 437A/437ASU RF Unit is a calibrated matched pair. Each matched pair is identified by serial number cross referencing.

1.2.1 MODEL 437A RF SOURCE CONTROL UNIT

A solid state plug-in assembly, the Model 437A RF Source Control Unit fits directly into the RF port of the Model 430 Mainframe or Model 4301A RF Unit Holder. The power supply and controller for the Model 437A/437ASU RF Unit are both contained within the Model 437A RF Source Control Unit. All control signals necessary to change the fundemental frequency of the YIG-tuned oscillator, contained in the Model 437ASU source, are generated within the Model 437A RF Source Control Unit. These control signals from the Model 437A are applied to the Model 437ASU via a supplied 2-foot interconnecting cable.

1.2.2 MODEL 437ASU RF SOURCE UNIT

The Model 437ASU RF Source Unit is a self contained assembly consisting of a YIG-tuned oscillator, an RF isolator, and a heatsink. The Model 437ASU is supplied with an output waveguide flange (UG-599/U) and is capable of delivering 4 milliwatts minimum of unleveled output RF power. Control signals, from the Model 437A RF Source Control Unit, tune the fundamental frequency of the YIG-tuned oscillator over a range of 26.5 to 40 GHz. As a self contained assembly, the Model 437ASU permits the physical point of RF output power to be placed near the location of use which minimizes the RF power losses common to waveguide.

1.3 ITEMS SUPPLIED

Items supplied with the Model 437A/437ASU RF Unit are listed in Table 1-1.

TABLE 1-1 ITEMS SUPPLIED

Qty.	Description	W/E Part No./Model No.
1	RF Source Control Unit	Model 437A
1	RF Source Unit	Model 437ASU
1	Signal Interconnection Cable (W1)	C139-744 was supplied with RF Heads
1	Calibrated Frequency Scale	B139-791
1	Signal Interconnection Cable (W2)	C139-807

1.4 SPECIFICATIONS

Table 1-2 lists the pertinent technical specifications for the Model 437A/437ASU RF Unit.

TABLE 1-2. MODEL 437A/437ASU RF UNIT SPECIFICATIONS

FREQUENCY

Range: 26.5 to 40 GHz
Accuracy* (all modes): ±1%
Linearity: ±1%

Stability:

With Temperature: 10 MHz/°C
With 10% Change in Line Voltage: <100 KHz
With 3:1 Load VSWR (all phases): <10 MHz

Peak Residual FM: 60 KHz

OUTPUT POWER

Unleveled RF Power: >4 mW
Power Variation: 6 dB max.
Spurious Signal Rejection:

Harmonics: >25 dBc
Non-harmonics: >50 dBc

Residual AM: >50 dBc

OUTPUT CONNECTOR: Waveguide Type UG-599/U

MODULATION

FM/Phase Lock Input:

±2 dB Frequency Response
±20 MHz Deviation: DC-100 KHz
Modulation Sensitivity (nominal): 135 MHz/Volt

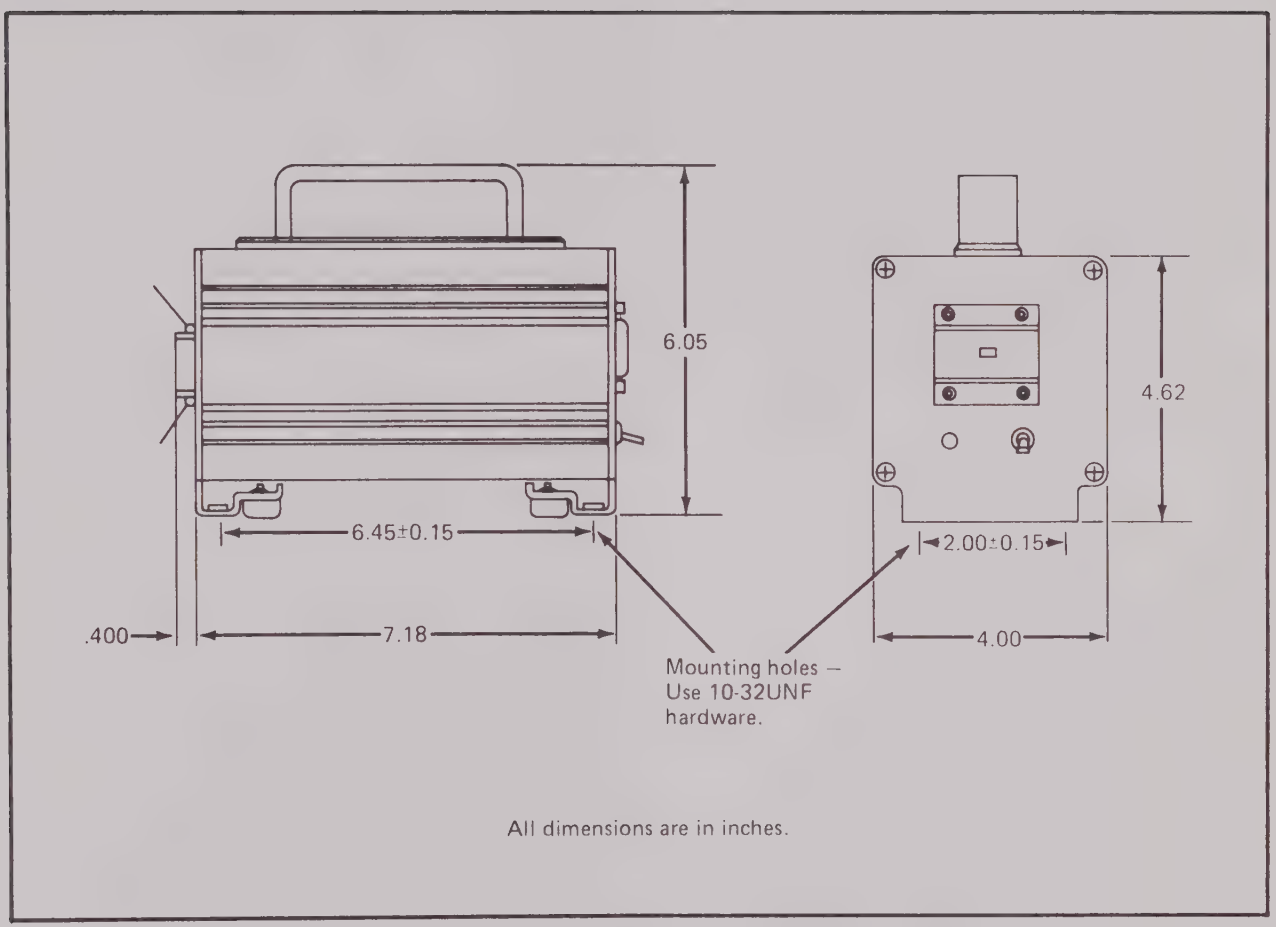
WEIGHT

Model 437A 5 lbs. (2.29 kg.)
Model 437ASU 6 lbs. (2.72 kg.)

DIMENSIONS

Model 437A: Fits into standard opening in Model 430 Mainframe.
Model 437ASU: See Figure 1-2.

* After 10 minute warm-up at 25°C



NOTE

Each Model 437A/437ASU configuration is matched by serial number and cannot be interchanged with other units.

Figure 1-2. Model 437ASU RF Source Unit, Outline Drawing

SECTION 2
INSTALLATION

2.1 GENERAL

Items of the Model 437A/437ASU RF Unit are shipped in a double carton and are cushioned between molded in-place plastic pads. Do not destroy the cartons or packing material until the equipment is thoroughly inspected and it is determined that reshipment is not necessary.

Installation of the Model 437A/437ASU RF Unit requires that each unit be separately and individually installed, then interconnected by appropriate supplied cabling.

There are no special power considerations for the Model 437A/437ASU RF Unit. Operating power is derived from the Model 430 Mainframe.

NOTE

Each Model 437A/437ASU configuration is matched by serial number and cannot be interchanged with other units.

2.2 OPERATING TEMPERATURE RANGE

The Model 437A/437ASU RF Unit together with the Model 430 Mainframe is designed to operate within its specifications when the ambient temperature is between 0°C and +40°C. Operating in ambient temperatures beyond these limits could affect the accuracy of the instrument and/or cause damage to its circuits.

2.3 INSTALLING MODEL 437A RF SOURCE CONTROL UNIT IN MODEL 430 MAINFRAME

CAUTION

Ensure that the fan on the rear of the Model 430 Mainframe is installed and operational when a Model 437A RF Source Control Unit is used. Otherwise, serious damage may occur within the unit.

If another RF Unit is to be removed from the Model 430 Mainframe first, them perform both step a and b procedures; otherwise perform step b only.

a. To remove an RF Unit:

1. Turn off power (via the PUSH ON switch).
2. Unfasten and remove the frequency scale from the Model 430 Mainframe by loosening two knurled screws.

3. Rotate the knurled LOCK knob on the RF Unit front panel counterclockwise. Draw the RF Unit out of the mainframe by pulling on the LOCK thumbscrew.

b. To install the Model 437A RF Source Control Unit:

1. Place the new frequency scale (furnished with the Model 437A RF Source Control Unit) on the Model 430 Mainframe and fasten it by its two thumbscrews.
2. Rotate the knurled LOCK knob on the Model 437A RF Source Control Unit front panel counterclockwise. Insert the unit into the RF port of the mainframe until its front panel is flush with the mainframe panel.
3. Rotate the knurled LOCK knob fully clockwise.

2.4 INSTALLING MODEL 437ASU RF SOURCE UNIT

The Model 437ASU RF Source Unit requires no installation, as such. Merely place it on any surface capable of supporting it, but it must be within 2 feet of its companion Model 437A RF Source Control Unit. Also, the Model 437ASU RF Source Unit should be placed near the location of use of its RF output.

2.5 CONNECTIONS

a. Connect one end of interconnecting cable W1 to the multi-pin connector (J6) on the front panel of the Model 437A RF Source Control Unit; connect the other end of W1 to the multi-pin connector (J1) on the rear of the Model 437ASU RF Source Unit.

b. Remove jumper from TB1 terminals 8 and 9 of the Model 430 Mainframe.

c. Connect interconnecting cable W2 to jack J1 on the rear of the Model 437A RF Source Control Unit and to the appropriate terminals of TB1 of the Model 430 Mainframe. The leads of the 430 end of W2 are identified and keyed to the appropriate terminals of TB1. Connect each lead to the TB1 terminal identified on the lead (i.e., lead marked "8" to TB1-8, etc.)

NOTE

Do not use cable W2 if the Model 437A RF Source Control Unit has been installed in a Model 4301A RF Unit Holder. Instead, refer to the Operation and Service Manual for the Model 4301A and use the cable supplied with the manual system.

d. Power may now be turned on at which time the equipment is ready for operation.

SECTION 3
OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section provides a detailed discussion of the operating controls, indicators, and connectors which are part of the Model 437A/437ASU RF Unit. Since these units are used in conjunction with the Model 430 Sweep Oscillator, a review of the operating instructions of that instrument is required to gain current familiarity.

3.2 PANEL DESCRIPTION

3.2.1 Model 437A

Figures 3-1 and 3-2 identify and explain the function of each Model 437A (control, indicator, and connector.

3.2.2 Model 437ASU

Figures 3-3 and 3-4 identify and explain the function of each Model 437ASU control, indicator and connector.

3.3 MODEL 437A/437ASU RF UNIT OPERATION

Once the Model 437A/437ASU RF Unit is installed and set up in accordance with the instructions given in Section 2, Installation, power is applied when the Model 430 is turned on. All normal controls and functions of the Model 430 are operable with the Model 437A/437ASU RF Unit. The PRESET M1 controls in the front panel of the Model 437A RF Source Control Unit are operable only when the Model 430 is in the SYM M1 and CW M1 modes. The SYMMETRICAL SWEEP WIDTH controls are operable only when the Model 430 is in the SYM M1 mode.

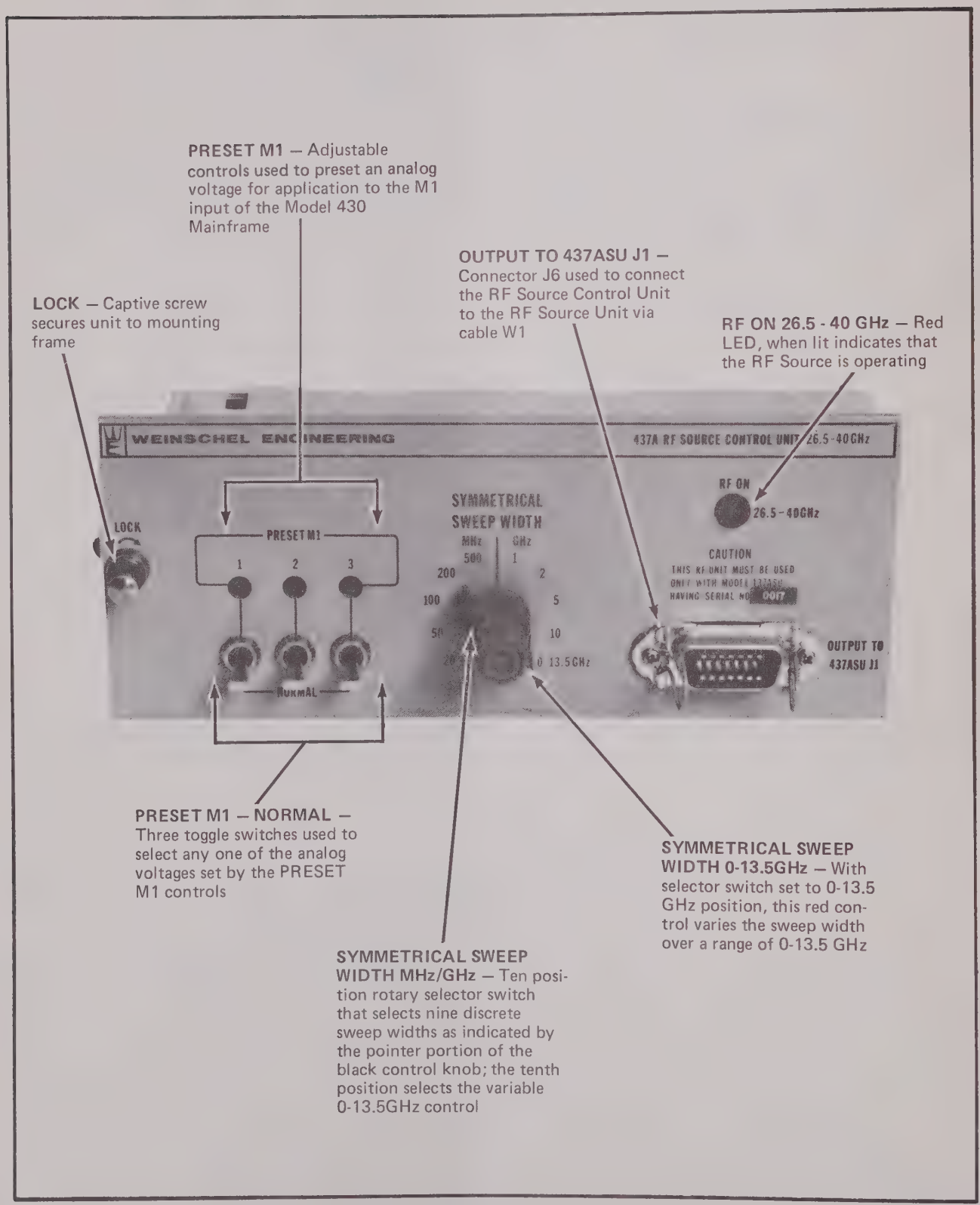
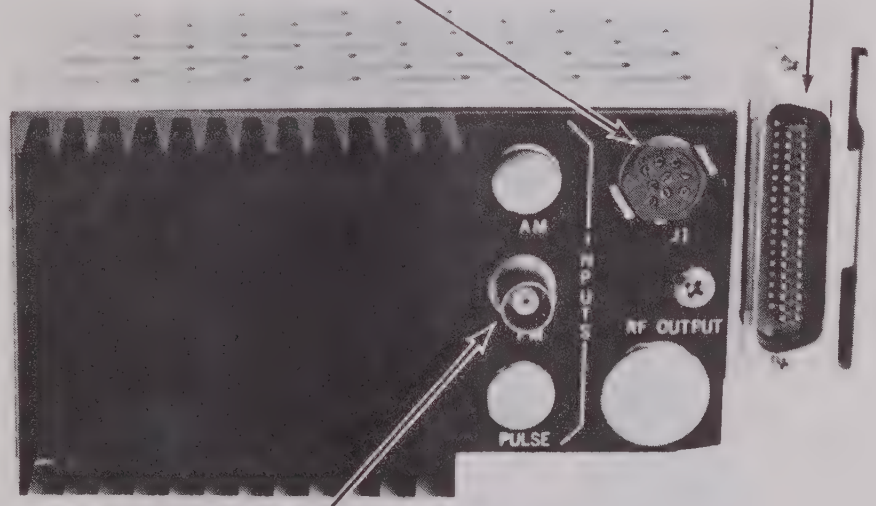

PRESET M1 — Adjustable controls used to preset an analog voltage for application to the M1 input of the Model 430 Mainframe
OUTPUT TO 437ASU J1 — Connector J6 used to connect the RF Source Control Unit to the RF Source Unit via cable W1
LOCK — Captive screw secures unit to mounting frame
RF ON 26.5 - 40 GHz — Red LED, when lit indicates that the RF Source is operating
WEINSCHEL ENGINEERING
437A RF SOURCE CONTROL UNIT 26.5-40GHz
LOCK
PRESET M1
1
2
3
NORMAL
SYMMETRICAL SWEEP WIDTH
MHz
GHz
500
1
200
2
100
5
50
10
0 13.5GHz
RF ON
26.5-40GHz
CAUTION
THIS RF UNIT MUST BE USED ONLY WITH MODEL 437ASU HAVING SERIAL NO. 0017
OUTPUT TO 437ASU J1
PRESET M1 — NORMAL — Three toggle switches used to select any one of the analog voltages set by the PRESET M1 controls
SYMMETRICAL SWEEP WIDTH MHz/GHz — Ten position rotary selector switch that selects nine discrete sweep widths as indicated by the pointer portion of the black control knob; the tenth position selects the variable 0-13.5GHz control
SYMMETRICAL SWEEP WIDTH 0-13.5GHz — With selector switch set to 0-13.5 GHz position, this red control varies the sweep width over a range of 0-13.5 GHz

Figure 3-1. Model 437A RF Source Control Unit, Front Panel Description



J1 — Multipin interface connector connects via cable W2 to TB1 of the Model 430 Mainframe (except if the Model 437A is installed in a Model 4301A RF Unit Holder in which case the cable supplied with the manual system is used; refer to Operation and Service Manual for the Model 4301A)

P1 — Multipin interface connector — connects directly to RF port connector (in Model 430 Mainframe, or Model 4301A RF Unit Holder)

FM INPUTS — Coaxial connector for input of frequency modulation (FM) signals

Figure 3-2. Model 437A RF Source Control Unit, Rear Panel Description

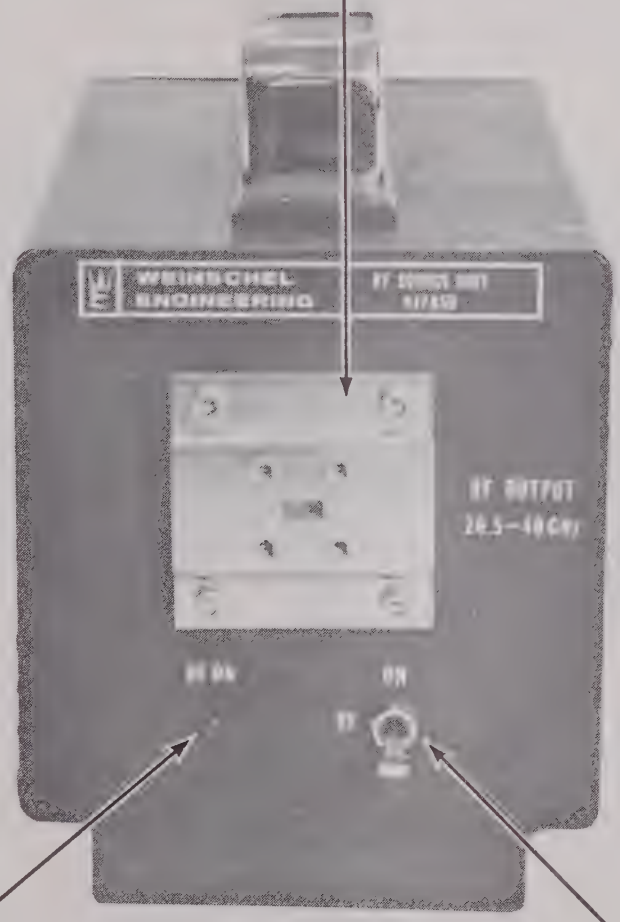

RF OUTPUT 26.5 - 40 GHz — The RF output port for the Model 437ASU RF Source which is a k band waveguide transition
WEINSCHEL ENGINEERING
RF ON — Red LED lights to indicate supply voltage is being provided to the RF Source unit
RF ON — Toggle switch which controls supply voltage to the RF Source unit (turns unit on or off)

Figure 3-3. Model 437ASU RF Source Unit, Front Panel Description

Figure 3-4. Model 437ASU RF Source Unit, Rear Panel Description

SECTION 4
PRINCIPLES OF OPERATION

4.1 INTRODUCTION

The Weinschel Engineering Model 437A/437ASU consists of two units that interconnect by cable to form one complete RF Unit which covers the 26.5-40 GHz frequency range. The Model 437A RF Source Control Unit contains all the circuitry required to interface with the 430 Mainframe and the major electronic circuits to control the Model 437ASU RF Source Unit. The RF Source is packaged in the small RF Source Unit to allow its placement close to the user's RF Waveguide Circuit. The major circuits of the Model 437A/437ASU are discussed in reference to an overall block diagram (Figure 4-1). The block diagram discussion is presented first to provide an overall understanding of circuit functions, then each of the major circuits is described in detail, with supporting simplified schematic diagrams where appropriate. Complete schematic diagrams are provided in Section 7.

4.2 OVERALL BLOCK DIAGRAM DESCRIPTION

The overall block diagram, Figure 4-1, includes major circuits within the Model 430 mainframe and shows their interrelationship with the circuits of the Model 437A/437ASU RF Unit. Referring to the "430 Mainframe" portion of Figure 4-1, in the sweep mode, the sweep trigger circuit reshapes and standardizes one of the negative-going input trigger signals selected by the front panel TRIGGER switch. The resultant positive output pulse triggers the sawtooth sweep generator circuit. A negative sawtooth voltage is generated and inverted by a precision ±10 volt limiting circuit. The resulting precision 10 volt sweep signal is then applied to a sweep processor/amplifier circuit where the sweep mode and start/stop limits of the sweep waveform are set by the front panel controls. This resulting composite sweep signal is now applied directly to the YIG tuning supply of the Model 437A; RF Source Control Unit; and, is referred to as the "tuning voltage signal" in the following discussions. The 430 mainframe also supplies all the DC power required by the Model 437A/437ASU. The +5.7 volts and the ±15 volts are provided as regulated voltages, while the remaining power is supplied as unregulated filtered DC which becomes regulated in the Model 437A.

The "tuning voltage signal" from the Model 430 mainframe (shown as a heavy signal line in Figure 4-1) is applied to the input of both the primary and secondary tuning loops. The primary tuning loop consists of an ultra-stable, low-noise, differential amplifier followed by a high-gain operational amplifier. The output from the operational amplifier is inverted, buffered, and applied to the YIG tuning coil driver circuit. The YIG tuning current, through the RF Source, determines the RF Source frequency; and, is sensed by a voltage developed across a resistance in series with the YIG tuning coil. This voltage provides the feedback signal which is applied to the main summing junction of the primary tuning loop thus forming a precision high gain closed loop voltage-to-current converter.

Because of the extremely high gain and precision of the primary tuning loop, it does not have a bandwidth sufficient to prevent slow rate limiting during the faster retrace periods. Therefore, a secondary loop is provided to prevent excessive delays and distortion during retrace intervals. The secondary loop is completely passive during the main forward sweep period.

Under certain conditions, the tuning voltage signal, applied to the Model 437A, may be sufficient to drive the RF Source beyond the normal operating frequency range. If this condition should occur, and no preventing action were taken, the RF Source could generate an erroneous output causing errors in over all system operation. To prevent this from happening, a high-

frequency clamp circuit is included in the feedback of the primary tuning loop. When the current through the YIG tuning coil causes the voltage developed across the sense resistor to exceed a predetermined value, the output of the high-frequency clamp circuit generates a secondary feedback signal. This signal is applied to primary tuning loop and limits the maximum value of YIG tuning current through the RF Source, thus preventing erroneous RF output signals.

The YIG tuning supply is required to process input signals ranging from DC to sweep rates of 100 sweeps per second. Obviously the latter requires a much greater bandwidth than the DC input requires. However, if the bandwidth is fixed at a width sufficient to accurately pass the current waveform required for 100 sweeps per second, the resulting noise, when operating at a fixed CW frequency, would be transformed into an excessive undesired residual FM on the RF output signal. To minimize the residual FM at Fixed frequencies and at slow sweep speeds, an auto bandwidth circuit is provided to automatically establish the bandwidth according to the instantaneous rate of change of the input tuning voltage signal. The output of a differentiator circuit, which continuously measures the rate of change of the input tuning voltage, generates the signal which switches a capacitor in parallel with the feedback resistance of the primary tuning loop to reduce the noise bandwidth at slow sweep rates and at fixed CW frequencies. Thus, minimum residual FM on the RF output signal is provided automatically.

The output frequency of the YIG tuned RF Source is determined by the magnetic field which exists at the location of the YIG sphere inside the RF source. This magnetic field changes, causing the RF Source output frequency to change, as the current through the YIG tuning coil changes, which is a function of the input tuning voltage signal. As the rate of change of tuning voltage increases, the resulting change in magnetic field laps behind, thus causing frequency errors, if not compensated accordingly.

The Model 437A includes a YIG LAG compensation circuit which allows the frequency accuracy at the highest sweep rate (100 sweeps per second) to be as good as at the fixed CW frequencies. The YIG LAG compensation signal is generated as a function of the rate of change of the input tuning voltage and summed with the input tuning voltage signal at the input to the primary tuning loop.

For phase lock and high speed FM requirements, a secondary wide bandwidth YIG tuning coil, having an air core, is provided in the RF Source to provide small, rapid, changes in output frequency according to the FM input voltage to the Model 437A. A wide bandwidth FM driver circuit converts the FM input voltage signal to a tuning current through the FM, air core, coil for all FM input signals above 1 KHz. All FM input signals below 1 KHz are applied to the input of the primary tuning loop and determine the current through the main YIG tuning coil (iron core).

Three preset Frequencies can be set via front panel controls on the 437A RF Source Control Unit when in either the SYM-M1 or CW-M1 modes of operation. Each of the three preset frequencies is selected by a toggle switch and set by a multiturn trim pot through the 437A front panel. When in the SYM-M1 mode, the center frequency can be preset and the sweep width can be selected via a front panel nine position Δf switch, as in the standard SYM-M1 mode.

The RF Source bias voltage is provided by the bias voltage regulator, located in the Model 437A. The input unregulated DC voltage for the bias voltage regulator is supplied by the 430 Mainframe. Since the RF Source is located outside the Model 437A, in the Model 437ASU, remote voltage sensing is used to insure accurate bias voltage at the remote RF Source. Two over voltage protection circuits, one in the Model 437A and one in the Model 437ASU, and one current limit circuit are included to prevent damage to the expensive RF Source in case of a circuit malfunction.

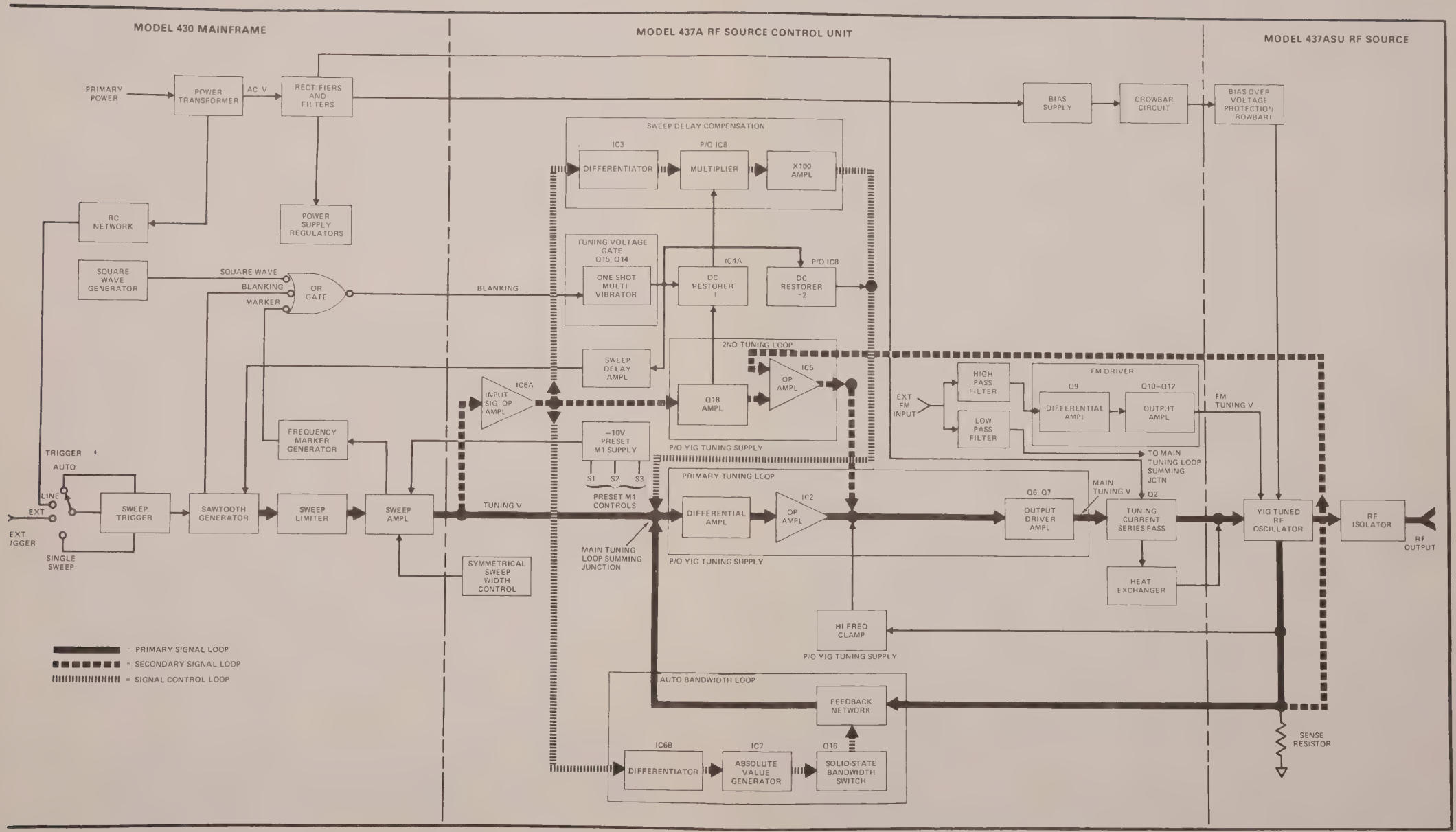


Figure 4-1. Model 437A/437ASU Overall Block Diagram

The Model 437ASU houses only the RF Source, the RF Source ferrite isolator, and the overvoltage protection and interface circuitry for the 437ASU. No RF Modulator is included in the Model 437ASU; however, several types of modulators are available for use in the 26.5 to 40 GHz range, and can be connected externally to the Model 437ASU. The Unit is small and quite portable with a rugged waveguide output flange, having four tapped holes, on the front panel of the Model 437ASU.

4.3 DETAILED CIRCUIT DESCRIPTIONS

Refer to the block diagram, Figure 4-1, as well as to the simplified schematic illustrations, which accompany the following circuit descriptions, and the detailed schematics provided in section 7.

4.3.1 YIG Tuning Supply (P/O Assy A2) (See Figure 4-2)

4.3.1.1 Primary Tuning Loop

The primary tuning loop is basically a high performance voltage to current converter and consists of Q8, IC2, Q7, Q6, and Q2 along with the associated circuit components. Q8 and IC2 make up a high gain, low noise operational amplifier with a current limited output circuit. Q7 and Q6 form an inverting buffer stage for driving the series pass transistor; Q2. The main tuning coil current (I_t), controlled by Q2, develops a proportional voltage (E_s) across R5; the sense resistor. E_s then provides the required stabilizing feedback voltage across R105; connected to the loop summing junction. Disregarding the YIG LAG compensation current through R51, the primary tuning loop amplifiers will control I_t such that $\frac{E_s}{R105}$ will exactly equal the sum of $\left(\frac{E_T}{R29}\right) + \left(\frac{+15}{R30'}\right)$; where the junction of R29,R30′ and R105′ is always at a zero volts (virtual ground) condition.

4.3.1.2 High Frequency Clamp

Under certain conditions, the input tuning voltage signal could cause I_t to exceed a safe operating limit. Exceeding this maximum limit could cause the oscillator to malfunction. To prevent this, a high frequency clamp circuit consisting of A3 (IC5A) and its associated components is included to limit I_t to a maximum value set by R86′ (R87). IC5A forms a high gain voltage comparator whose output signal can override the output signal from A1(IC2), thus controlling the drive to Q7 and Q2. The high frequency clamp circuit is configured so that I_t is limited to that value which causes $\frac{E_s}{R83}$ to equal $\frac{+15}{R86'}$; disregarding the YIG Lag compensation voltage across R137. Therefore, the input tuning voltage (E_t) controls I_t only up to the clamp limit set by R86′(R87).

4.3.1.3 Secondary Tuning Loop

The secondary tuning loop functions in a manner similar to the high frequency clamp circuit. It also has the ability to override the output of A1 and control the drive to Q7 and Q2. The secondary loop is always passive during the forward sweep and at fixed frequencies. However, when sweeping at the faster sweep rates, the A1 amplifier experiencies slew rate limiting during the retrace interval, since the retrace rate is approximately 10 times greater than the forward sweep

rate. The secondary loop amplifier A4(IC5B) detects the slew rate limiting of A1 by constantly comparing E_t to (kE_S-A), where k is a scaling constant and A is an offset constant. Disregarding the YIG LAG compensation signal, when no slew rate limiting occurs, E_t will equal (kE_S-A)

$$\frac{E_T}{R107'} = \frac{E_S}{R84} - \frac{15}{R88'} \qquad k = \frac{R107}{R84} \qquad A = \frac{R107(15)}{R88}$$

Any difference between E_t and (kE_S-A) is amplified by the A4 amplifier. During the very short retrace intervals when A1 is experiencing slew rate limiting, the output of A4 overrides the output of A1 to Q7 and controls the drive to Q7 directly in order to decrease I_t at a very fast rate and greatly minimize the recovery delay of A1. The secondary logs can only reduce I_t relative to A1's drive command; it cannot cause I_t to be greater than that of A1's command. CR30 prevents the output of IC5B from going more negative than 0.7 volts below ground potential. CR28 disconnects the secondary loop from the primary loop under normal operating conditions.

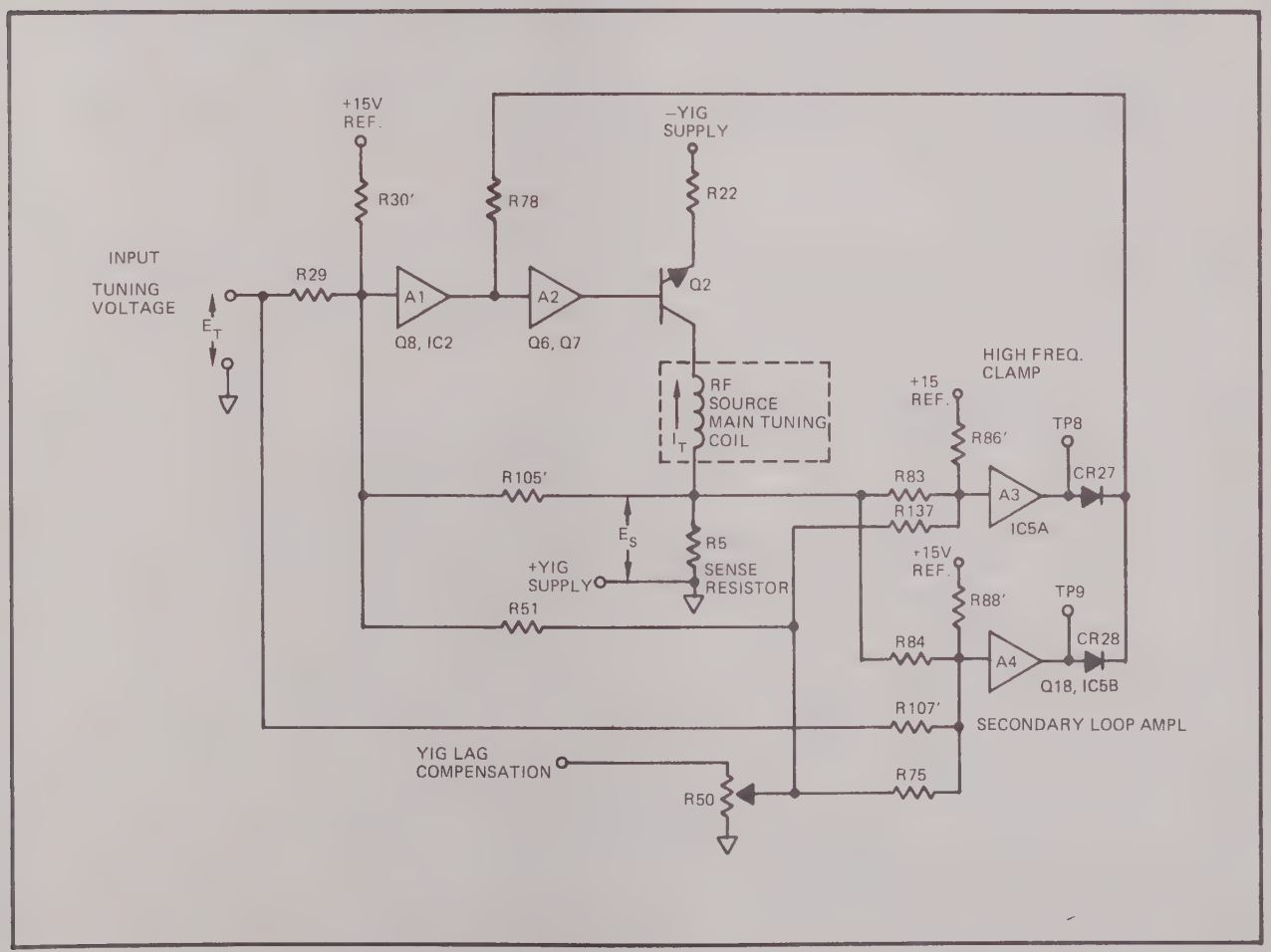


Figure 4-2 YIG Tuning Supply, Simplified Schematic Diagram

4.3.2 Auto Bandwidth Circuit

During normal operation, while in the swept mode and at maximum sweep speed, the full bandwidth of the YIG tuning supply (the primary tuning loop) is required so that no undesired distortion is present on the forward sweep drive signal to the RF source. At slower sweep speeds, and in the CW mode, the bandwidth requirement is reduced because of the slow changing waveform. If the bandwidth is reduced, the noise on the YIG tuning signal will be reduced in proportion to the square root of the bandwidth, and thereby reduce the undesired residual FM on the RF output signal.

In the Model 437A, the tuning supply bandwidth is automatically controlled in accordance with the rate of change of the input tuning voltage signal. A simplified diagram of this circuit is shown in Figure 4-3. the bandwidth is primarily determined by R105 and C29 or C30. The maximum bandwidth occurs when Q16 is an open circuit, while the minimum bandwidth is achieved by switching C30 in parallel with C29 by turning on Q16.

The state of Q16 is controlled by the absolute value generator circuit (IC7A and IC7B) which, in turn, is controlled by the output of the differentiator circuit; IC6B. The differentiator (Figure 4-4) provides an output voltage proportional to the rate of change of the input tuning voltage signal. The time constant is primarily determined by C27 and R97. C26 and R96 are necessary to limit differentiator output noise and to improve circuit stability. The diode bridge and CR35 limit the positive or negative output of the differentiator circuit.

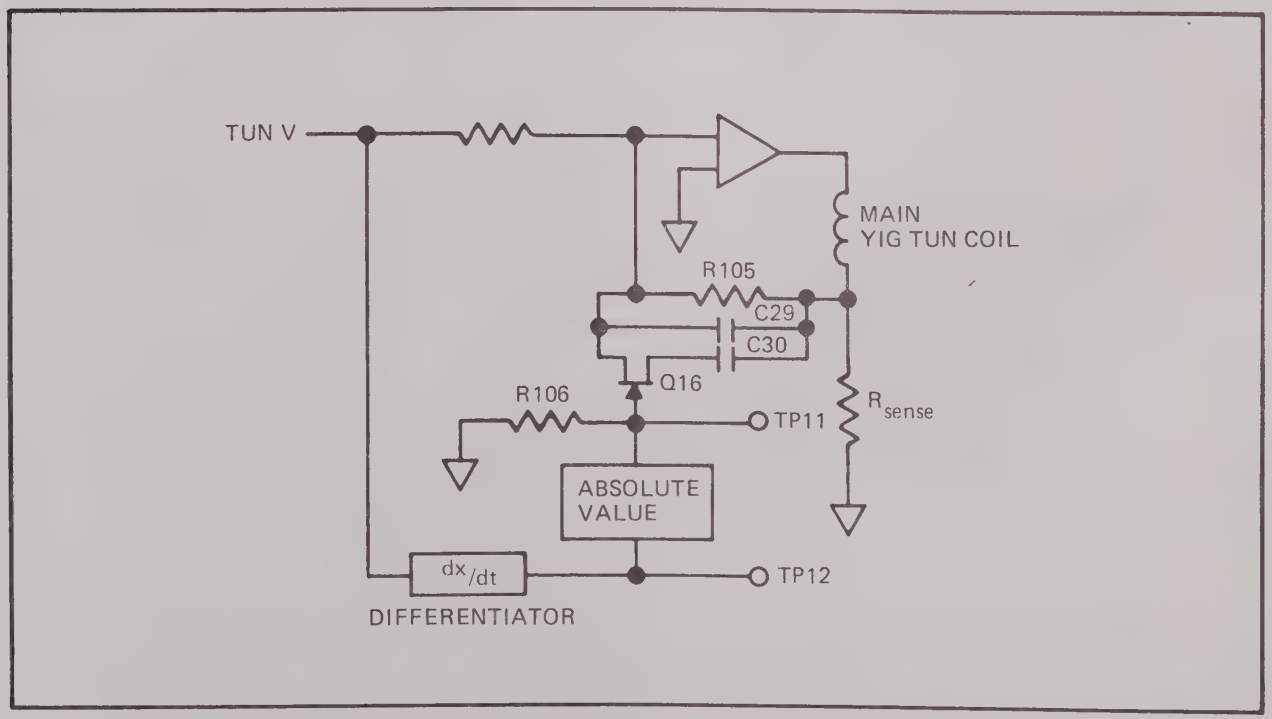


Figure 4-3. Autobandwidth Circuit Simplified Schematic Diagram

The absolute value generator is shown in Figure 4-5. Amplifier A1(IC7B) is an operational summing amplifier which generates the sum of two signals: the input V1 and the output V2 from A2(IC7A). When V1 is negative the gain of A1, via R94 is twice the gain via R93 and the resulting output is equal to -V1. When V1 is positive, amplifier A2 is disconnected from A1 by virtue of the diodes in its feedback path which reduce its output to 0 volts. Hence, only A1 is operative and the output is again equal to -V1.

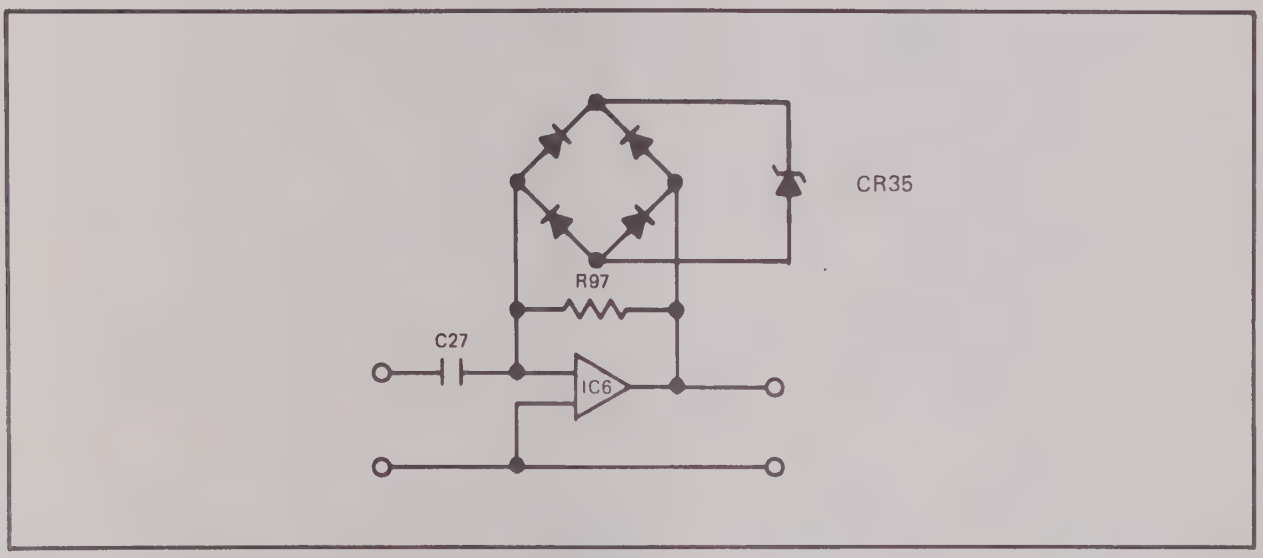


Figure 4-4. Differentiator, Simplified Schematic Diagram

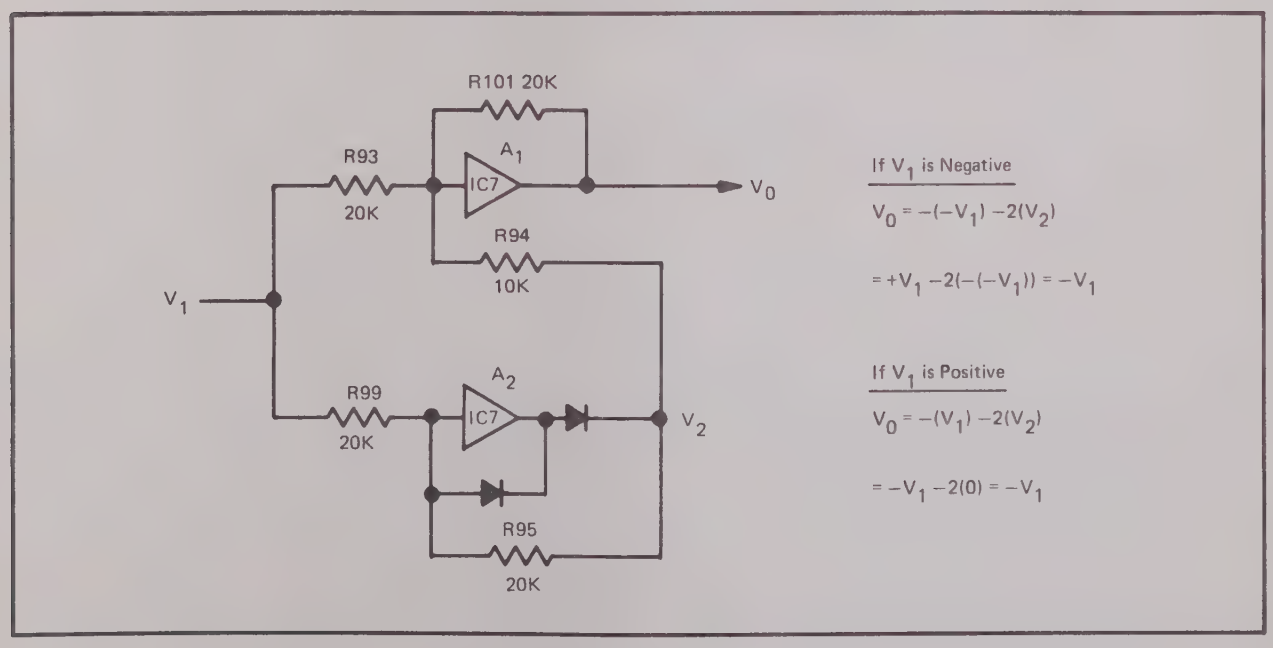


Figure 4-5. Absolute Value Generator, Simplified Schematic Diagram

The output of A1(IC7B) is applied through a disconnect diode CR39 to the gate of Q16. The auto bandwidth circuit, due to CR39 and the RC network of R106 and C31, is able to increase the tuning supply bandwidth very rapidly; and, to decrease the bandwidth relatively slowly.

Q17, and the associated components, allow the auto bandwidth to be forced into the wide bandwidth mode regardless of the output of the differentiator circuit.

4.3.3 Sweep Delay Compensation

It is normally assumed that the RF output frequency changes in synchronism with the tuning voltage signal applied to the input of the YIG tuning supply. However, this is true only at slow sweep rates and cannot be realized at high sweep rates because of the non linearities associated with the magnetic YIG tuning mechanism of the RF Source. As sweep rate is increased, the linear relationship between RF frequency and tuning coil current is distorted and produces a detectable frequency shift or lag. This effect is most noticable at the highest sweep rate.

Since this sweep delay distortion is not inside the closed loop of the YIG tuning supply, a compensation signal must be introduced and combined with the input tuning voltage signal. The summation of these two signals provide a compensated tuning current signal which is time sensitive and non linear in such a way that the resulting RF output frequency has a nearly linear relationship with the input tuning voltage signal.

The circuit used to provide the compensation signal is shown schematically in Figure 4-6. The essential characteristics of the compensation signal can be seen in the waveform at TP6. There is a step component summed with a ramp component. The step is formed by differentiation of the input tuning voltage signal. The ramp component is generated by multiplying the CD restored tuning voltage sawtooth by the scaled output of the differentiator. The ramp signal is combined with the step signal in IC4B. The composite YIG Lag compensation signal appears at TP6 and is developed across R50. As the sweep rate increases, the output from the differentiator increases. This results in an increase in the step height and an increase in ramp slope.

To adjust the circuit for optimum compensation, R50 is set to approximately mid range. R61 is then selected to provide the desired ramp slope and R130 and R129 are selected to provide the correct step amplitude as a function of sweep rate. R130 must always be set equal to R129; however, R130, R129, and R61 are all factory select as test components and should not require reselection in the field unless a different type RF Source is installed in the Model 437ASU. Only R50 should be adjusted to set the YIG LAG compensation.

The tuning voltage signal is applied to the input of the differentiator circuit via the unity gain voltage follower; IC6A. The differentiator is basically an operational amplifier with a capacitor, C16, forming the main input impedance, and a resistor, R54, providing the main feedback impedance. R53 and C17 are added to provide the required stability and to limit the noise bandwidth. The output of IC3, at pin 6, is a negative voltage proportional to the rate of change of the positive going input tuning voltage. This negative voltage determines the current supplied to the emitters of the differential pair which forms a type of transconductance multiplier. The value of current supplied to the emitters determines the gain of the differential stage, and therefore, the amplification of the DC restored tuning voltage signal applied to one input of the multiplier via R61. The signal at TP-14 is a replica of the input tuning voltage with the DC component removed by the transistor connected to pins 3, 4, and 5 of IC8. This DC restoration circuit is activated by the one-shot multivibrator formed by Q14 and Q15; and, which is triggered by the positive going transition of the blanking pulse applied to C24.

The DC restored tuning voltage, after being amplified by the multiplier; appears as the difference voltage between the two collectors connected to R63 and R64. This difference signal is separated from the common mode voltage at the collectors of the multiplier by IC4B, which also amplifies the difference voltage by a factor of 100. In addition, the step portion of the composite YIG lag compensation signal, generated by the differentiator, is summed with the ramp portion of the signal via R130. Therefore, the output of IC4B is the composite YIG lag compensation signal riding on a DC voltage. The transistor, connected to pins 1, 2, and 3, of IC8, removes the DC component and references the YIG lag compensation signal to zero volts; ground potential. The DC resotration circuit (#2) is also controlled by the one-shot multivibrator. R50 is adjusted to provide the required amplitude of YIG lag compensation to be applied to the summing junction of the main tuning supply via R51.

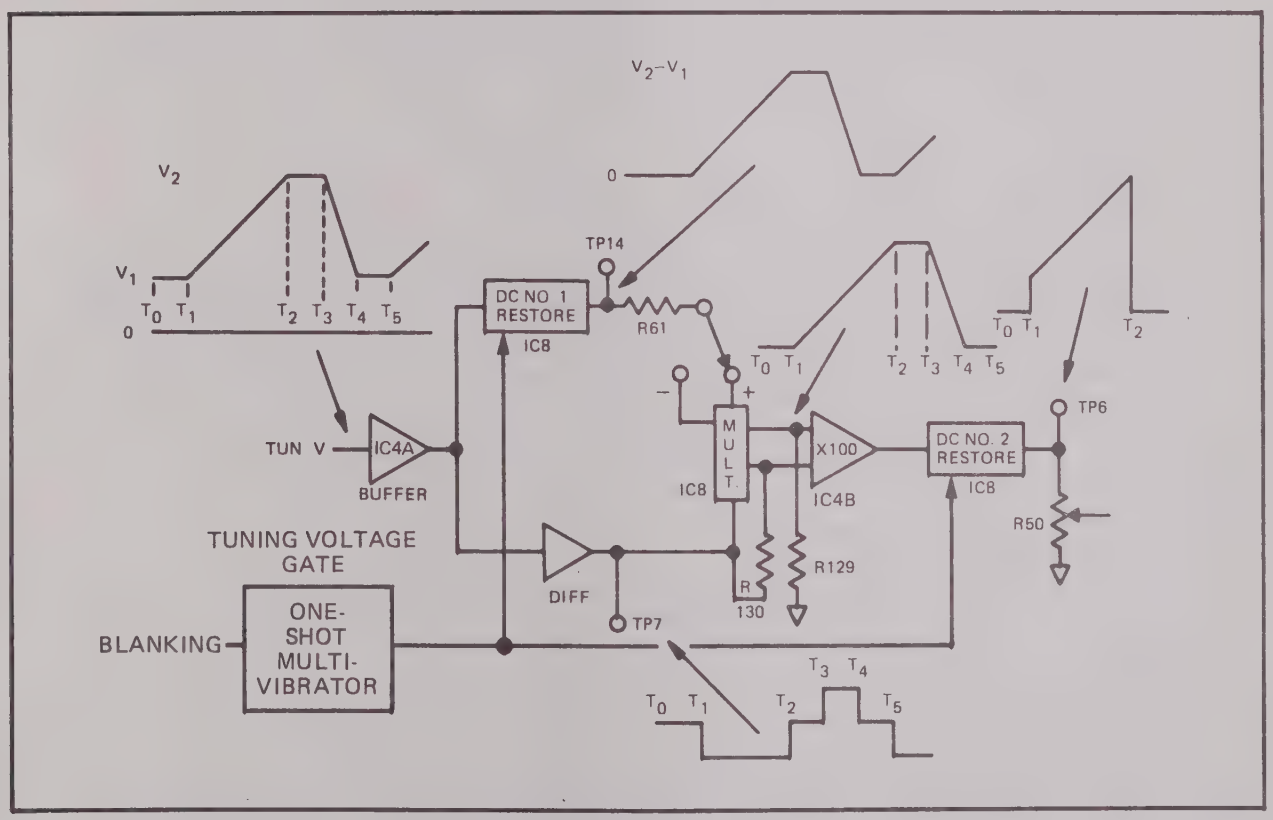


Figure 4-6. Sweep Delay Compensation Simplified Schematic Diagram

4.3.4 FM DRIVER

The method for providing a direct-coupled wideband FM input is shown in Figure 4-7. The FM input signal is frequency multiplexed via a high-pass and low-pass filter which, in turn, feed the FM signal frequency components to the FM YIG tuning coil and the main YIG tuning coil of the RF source, respectively.

The FM coil is a special winding in the YIG tuning structure which has an air core and therefore can operate at high frequencies. Having lower "core-loss" at higher frequencies, the air core thereby provides wideband performance. The lower permeability of air, compared to the iron core, reduces the flux density for a given magnetizing current; and, for this reason the FM coil cannot cause large frequency deviations. Large deviations are possible for frequencies from 0 (DC) to approximately 1 KHz through the low-pass filter consisting of R26, R27 and C7, and the main YIG tuning supply. Frequencies above 1 KHz are routed to the FM driver circuit via the high-pass filter consisting of C11 and R36.

The basic operation of the FM driver is very similar to that of the main tuning coil driver. A wide bandwidth operational amplifier is formed by Q9, Q10, Q11, Q12, and associated components. The base of Q9, at the junction of R36 and R40, is held at a virtual ground because of the closed loop feedback from the current sense resistor, R85.

4.3.5 -10 VOLT PRESET M1 SUPPLY

The -10 volt preset M1 supply provides a method of presetting a specified analog voltage that is input to the Model 430 Mainframe to control the CW M1 fixed frequency or the center frequency when in the SYM M1 mode. This analog voltage is developed by tapping off the desired value from one of the three trim pots accessable through the front panel (R14, R15, and R16). The -10 volts which is constantly applied to the top of the three trim pots is developed by the +15 volt reference supply and an operational amplifier, U1 and Q4, which has a DC gain, established by R12 and R11, of $\frac{10}{15}$, or 0.667.

4.3.6 BIAS SUPPLY CIRCUIT

The bias supply circuit consists of a bias regulator, threshold current controller, and a bias voltage programming circuit; refer to Figure 4-8.

4.3.6.1 Bias Regulator

The bias regulator furnishes the DC power required to drive the GUNN-diode oscillator of the YIG tuned RF Source. A simplified schematic diagram, Figure 4-8 shows the regulator in a positive-output configuration.

The regulator is a typical operational amplifier design using a series-pass transistor, an externally generated reference voltage and a feedback network. The design also includes a foldback current limiter, (discussed in 4.3.7.4), and provisions for varying the bias voltage as a function of the tuning voltage, (discussed in 4.3.6.3).

Because the operational amplifier, IC1, has a very high open loop gain, the output drive voltage to the series-pass transistor (Q1) will be such that the conduction of Q1 will cause the voltage at the junction of R6, R8, and R9 to equal zero volt (virtual ground), since the inverting input to IC1 is referenced to ground. The regulated + Bias output voltage, therefore, must be a value

which will cause the current through R8 to exactly equal the current through R9, assuming zero current through R139. Since the current through R9 is determined by the value of R18, varying R18 will cause the + Bias output voltage to vary so that the junction of R6, R8, and R9 will always equal zero volt; virtual ground.

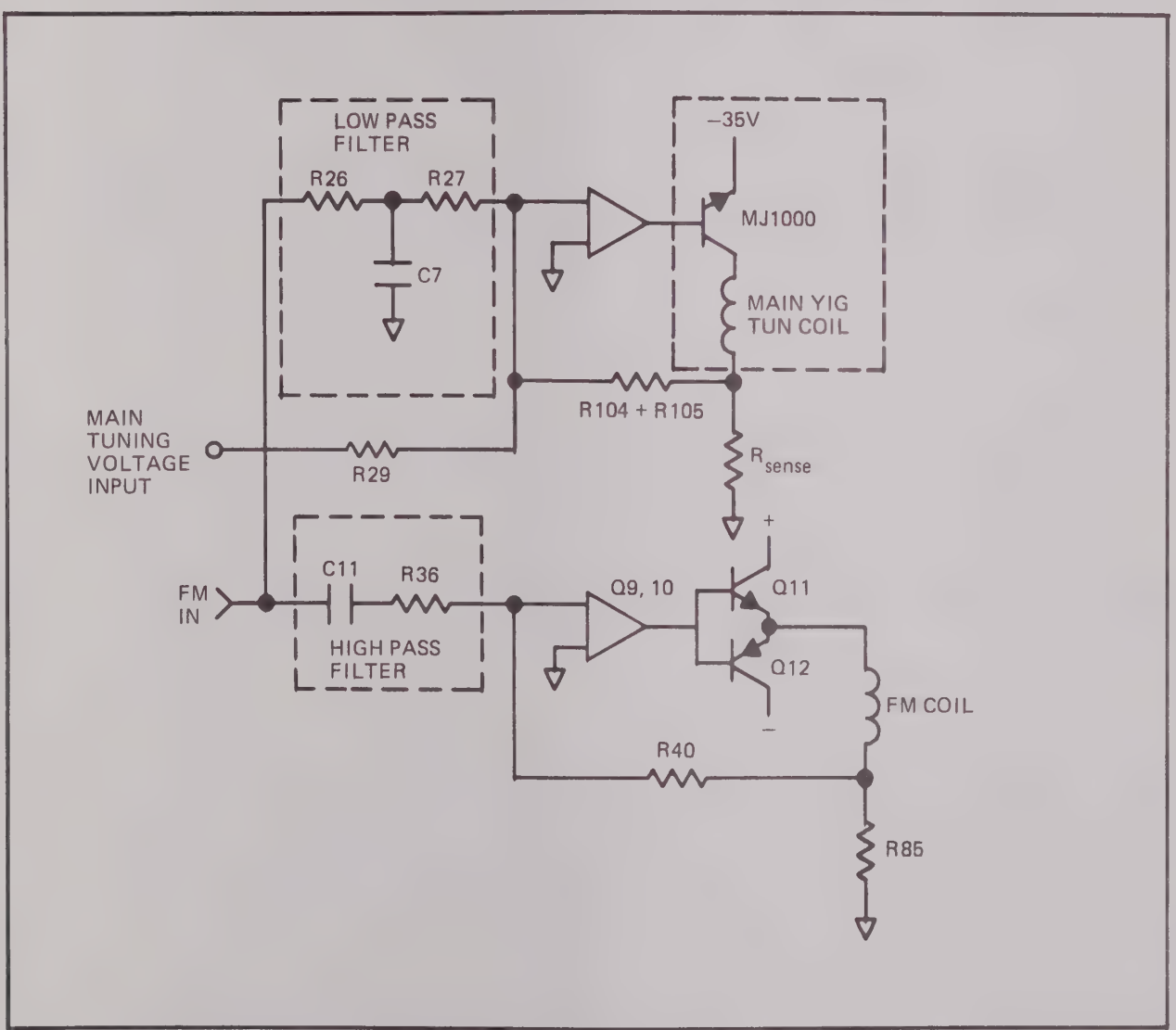


Figure 4-7. FM Driver Circuit, Simplified Schematic Diagram

The output Bias voltage can also be changed by causing current flow through R139. Most Model 437ASU RF Sources require that the Bias voltage be varied linearly as a function of the output frequency (or tuning voltage). The bias voltage programming is accomplished by applying the tuning voltage signed to A12U3. The gain and polarity are set so that the required current flows through R139, as a function of tuning voltage, thus causing the bias voltage to change accordingly, (discussed in 4.3.6.3).

The purpose of Q19 is to prevent the bias voltage from being applied to the RF Source before the +15 volt power is available upon initial system turn on.

Transistor Q1 provides the current limiting function by monitoring the voltage across R2. R1 and R3 form a voltage divider that provides the "foldback" characteristic of the current limiting circuit, (discussed in 4.3.7.4).

Relay K1 is used to reduce the equivalent regulator reference voltage to zero volt, when energized; and, therefore causing the bias voltage to be reduced to approximately zero volt. K1 can be energized by either the front panel RF ON/OFF switch on the Model 437ASU, or remotely via the rear panel connector of the Model 430 Mainframe.

4.3.6.2 Threshold Current Controller

The threshold current controller functions only during the initial turn on of the bias voltage regulator. It momentarily overrides the current limiter circuit so that the regulator can supply the additional current required to start the oscillator. When oscillation starts, the current drawn by the GUNN diode is reduced and the threshold current controller is no longer required.

Upon initial turn on, A12C20 has no change; and, as the bias voltage from the regulator rises very rapidly at turn on, A12C20 causes A12Q4 to saturate, thus disabling the current limiting circuitry (A2Q1). After approximately 0.5 seconds, A12C20 has accumulated a charge sufficient to allow A12Q4 to turn off, and to allow the current limiting circuitry to function as required.

4.3.6.3 Bias Voltage Programming Circuit

The bias voltage programming circuit varies the bias regulator output as a function of the tuning voltage input, in order to achieve optimum RF Source performance. Programming for the Model 437A RF Source Control Unit consists of inserting jumpers between pins F to E and D to G to provide the proper programming polarity. This provides a non-inverting 0 to +12 volt ramp signal at the output of A12U3. A2R139 is selected at test consistent with the requirements of the particular RF Source.

4.3.7 PROTECTIVE CIRCUITS

A number of protective circuits (some of which are included in Figure 4-1, provide protection against damage to the expensive RF YIG tuned RF Source. Redundancy is present in the protective circuitry to assure that the expensive RF YIG-tuned source will not be damaged accidently due to other component failure.

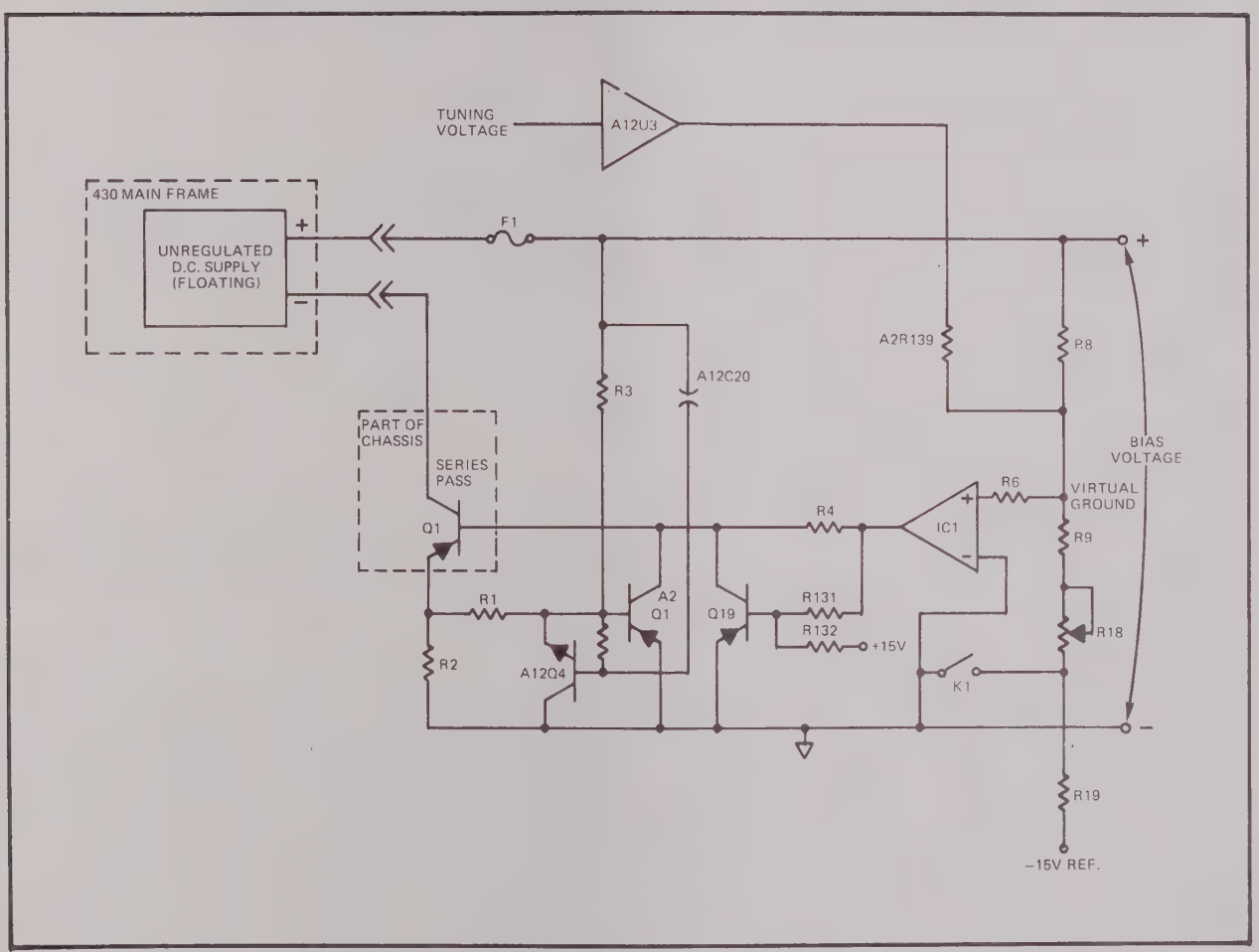


Figure 4-8. Bias Supply, Simplified Schematic Diagram

4.3.7.1 Crowbar Circuit

The crowbar circuit is illustrated in Figure 4-9. Its purpose is to provide protection to the Model 437ASU RF Source in the event that the bias supply voltage exceeds the maximum safe limit specified on the particular RF source. When an overvoltage condition exists, the circuit causes SCR A13CR1 to turn on thus short circuiting the bias supply and reducing the output voltage to nearly zero volt. The ± sense lines to A13Q1 are the bias voltage output from the bias supply. The threshold or trip voltage, at which overvoltage sensing circuit A13U2 triggers the gate of the SCR (A13R1), is determined by selecting the proper value of resistor A13R2 at test. Capacitor A13C1 prevents false tripping of A13U2 by noise, which would not normally harm the RF Source. An over voltage condition of approximately 1.5 ms duration is required to activate the crowbar circuit.

4.3.7.2 Heat Exchanger

In the higher frequency bands for YIG tuned RF Sources, the tuning current, and consequently the tuning power, is quite high (i.e. 30 to 40 watts). To avoid dissipating all of this power in one series-pass transistor in the main tuning supply, and cause intensive heat dissipation at one location, some of the tuning current is supplied by Q2, (Figure 4-10), which is a constant-current generator. Therefore, the full Δ portion of the tuning current, along with only a small portion of constant quantity need be handled by the main tuning loop series-pass transistor. The main tuning supply will, however, function properly with the heat exchanger circuit disabled, (i.e. during troubleshooting).

4.3.7.3 Inhibiting Delay

When the AC line power is first applied, as during a normal equipment turn on, the sequence of turn on for the ±15 volt supplies is relatively uncontrolled. As a result, the output of the bias supply could overshoot the desired value during the time interval between power on and stabilization of the ±15 volt supplies.

To prevent overshoot, Q19 is wired in shunt with the drive to the output series regulator. In normal operation, the output of IC1 is negative and Q19 is biased off, causing it to have no effect on the operation of the bias supply. However, assume that the +15 volt supply is up and stabilized before the -15 volt supply reaches its final value. Under this circumstance the output from IC1 will be positive and keep the output series pass cutoff; thus the output of the bias supply would be zero. Next, assume that the -15 volt supply is up and stabilized before the +15 volt supply. Q19 will be biased "on" via R132, causing any drive current to the output series-pass transistor to be shunted away through Q19 and the output of the bias supply will again be zero.

As the lagging supply voltage reaches its normal level, the bias supply will smoothly rise to its level with no overshoot.

4.3.7.4 Current Limiting

The basic current limiting circuit consists of transistor Q1 and resistor R2. As the bias supply load current exceeds the desired load current limit, the voltage drop across R3 increases in a direction which causes A2Q1 to conduct, thereby shunting the drive current away from the series-pass transistor. This action causes the output bias supply voltage to drop to a level that will maintain the load current constant and equal to the level set by the value of R2.

A feedback network is applied to the basic current limit transistor A2Q1, via R1 and R3, to generate a "foldback" characteristic that will cause the load current to stabilize at a much lower

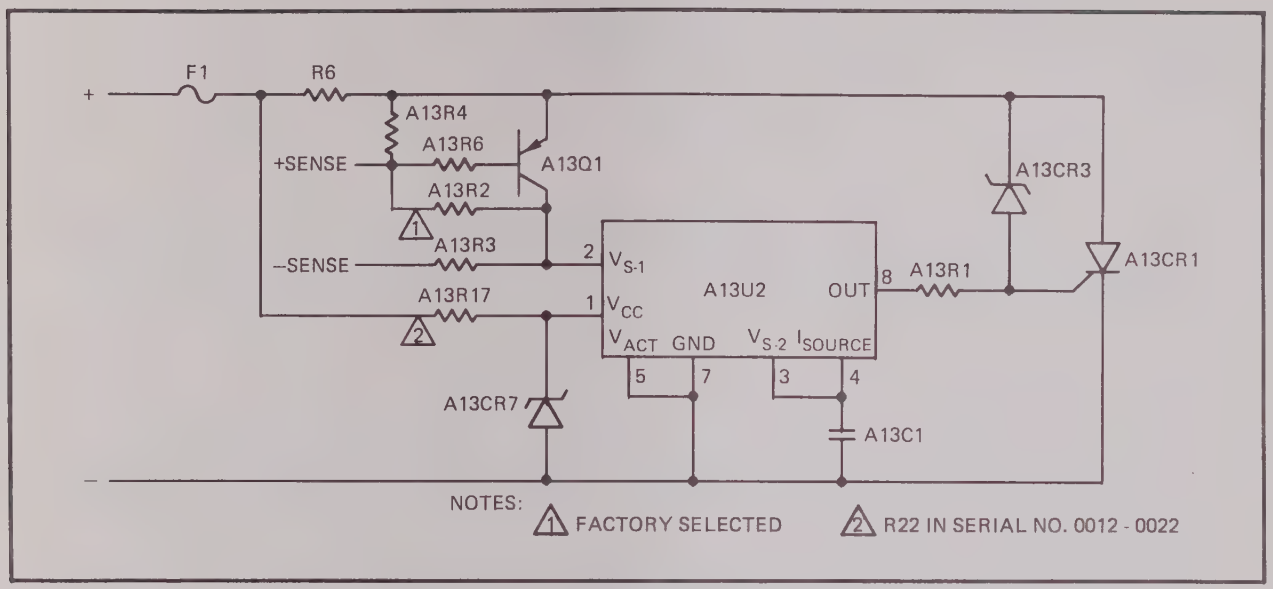


Figure 4-9. Crowbar Circuit

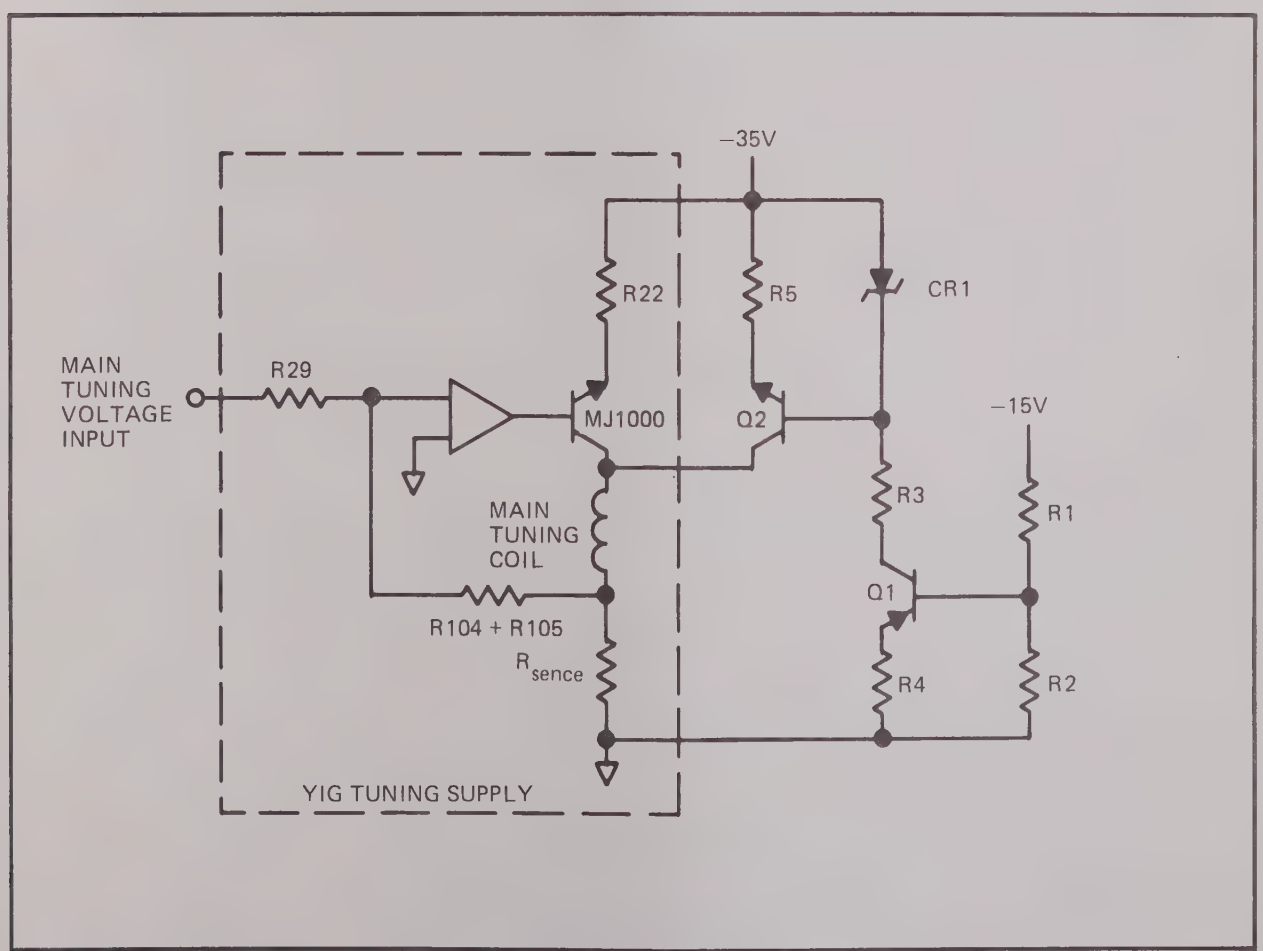


Figure 4-10. Heat Exchanger Circuit

value after the current limiting circuit has been actuated. This feature reduces the power dissipated in the series pass transistor if the output of the bias supply remains short circuited for an indefinite period of time.

4.3.7.5 Fuse

If circuit components of the current limiting circuit should fail, and an increase in load current occurs, fuse F1 is designed to open and thereby protect the RF Source. Fuse F2 is included to protect Q2 and the RF Source if excessive current is drawn due to heat exchange failure.

4.3.7.6 RF Source Overvoltage Protection

The overvoltage protection circuit is located on the A1 circuit board of the Model 437ASU RF Source Unit. This circuit, which is similar to the crowbar circuit described in paragraph 4.3.7.1, protects the YIG-tuned RF source from overvoltage transients and failure of the bias voltage regulator. When transients or a failed bias regulator occur, the overvoltage circuit trips, causing SCR (A1CR1) to go into crowbar conditions. Overvoltage sensing circuits A1U1 contains two operational amplifiers whose voltage sensing inputs are tied together to sense any overvoltage condition within the shortest possible propagation delay. The threshold, or trip voltage, at which A1U1 triggers the gate drive to the crowbar SCR (A1CR1) is determined by selecting the proper value of resistor for A1R1. Zener diode A1CR3 is selected such that the diode voltage is approximately 0.8 volt above the crowbar trip voltage.

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides the information required for service and maintenance of the Model 437437ASU RF Unit. Each performance check, calibration procedure and alignment procedure provides instructions for Model 430 Mainframe control settings and a simplified test setup diagram.

5.2 REQUIRED TEST EQUIPMENT

Test equipment other than that listed in Table 5-1 may be used if the equipment specifications are equal to, or exceed, the required characteristics. Each item of test equipment used to service the Model 437A/437ASU RF Unit should be a recently calibrated item.

TABLE 5-1. REQUIRED TEST EQUIPMENT FOR PERFORMANCE AND CALIBRATION TEST

TITLE	REQUIREMENTS	Suggested Mfg. and Model No.
Variable Transformer	105-125 VAC, 2 AMP	General Radio, W5MT3A
Multimeter	3 1/2 Digit, ±0.1% Accuracy	Keithley, 177
Oscilloscope	Dual Channel, DC to 300 KHz	Gould, OS 3300B
Spectrum Analyzer		HP MOdel 8555A
Adapter	26.5 to 40.0 GHz	HP Model 11520A
Function Generator	DC to 100 KHz, Sine Wave, Square Wave	Wavetek, 185
Power Meter	±0.3 to 40.0 GHz	HP MOdel R486A
Frequency Meter	26.5 to 40.0 GHz	HP Model R532A
Variable Attenuator	26.5 to 40.0 GHz	HP Model R375A
Crystal Detector	26.5 to 40.0 GHz	HP Model R442A

5.3 PERFORMANCE TESTS

The following performance tests are performed to verify whether the Model 437A/437ASU RF Unit is operating within the specifications stated in Table 1-3. These performance tests should be used as initial installation setup, operational checks or as a performance check after equipment repair.

NOTES

1. Each Model 437A/437ASU configuration is matched by serial number and cannot be interchanged with other units.

2. The Model 437A RF Source Control Unit must be installed in the Model 430 Mainframe and the Model 437ASU RF Source Unit must be connected to the Model 437A before starting the following performance procedure.

5.3.1 FREQUENCY ACCURACY

a. Connect the equipment as shown in Figure 5-1.

b. Set the Model 430 Mainframe controls as follows:

Front Panel

TRIGGER: AUTO	SWEEP FUNCTION: F1-F2
SWEEP TIME (SEC): .01 Sec	SWEEP TIME (SEC) VARIABLE: cw
F1: Low Mechanical Limit	F2: High Mechanical Limit
M1: Nominal Low End of Band	M2: Nominal High End of Band

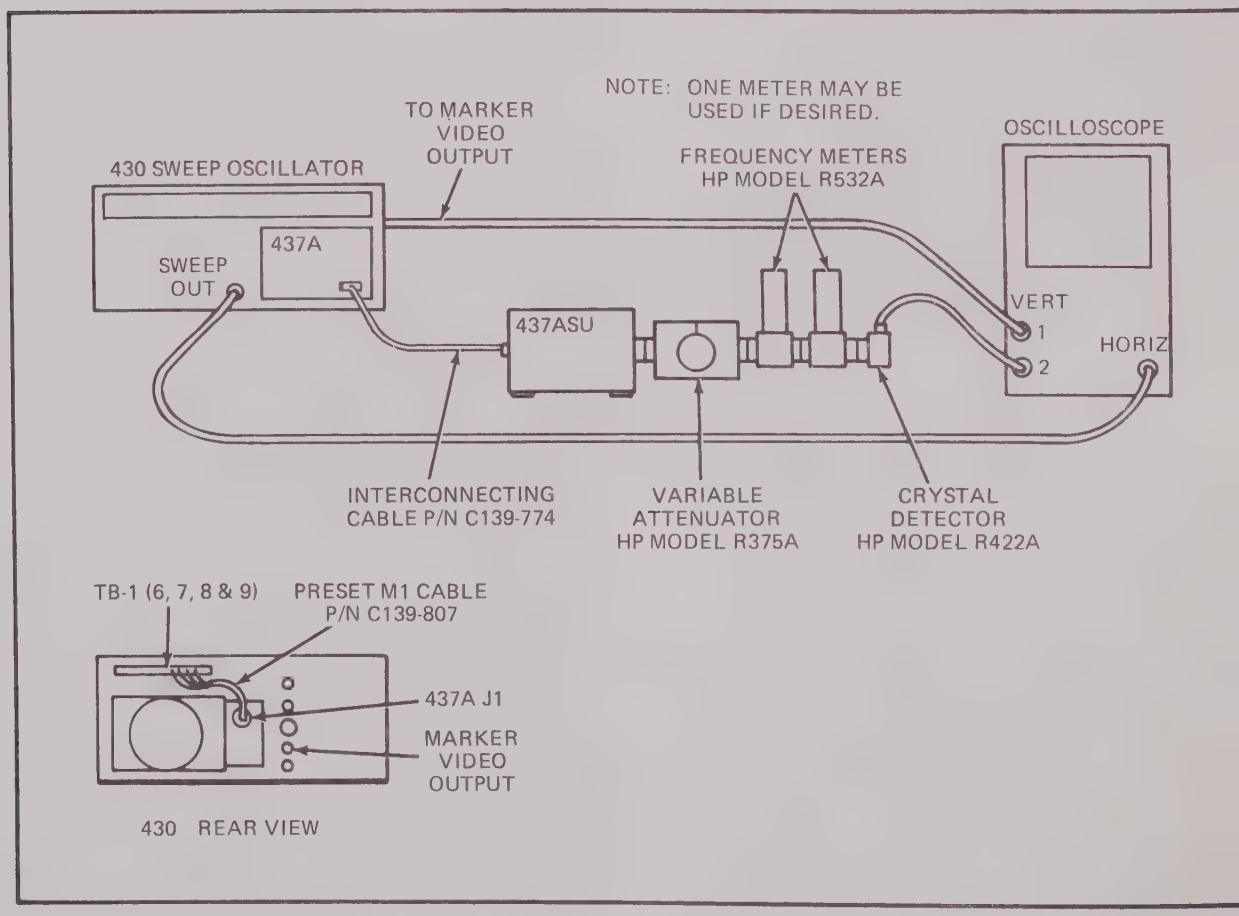


Figure 5-1. Performance Test Set-Up

Front Panel (Cont.)

1 KHz ⊓⊔: OFF

MARKER AMPLITUDE: Center

Rear Panel

SWEEP RESPONSE TIME: AUTO

RF DURING RETRACE: OFF

RF MARKER: ON

PROPORTIONAL OUTPUT: 40V/OCTAVE

SYM MARKERS: CALIBRATED

JUMPER SWITCH: OFF

c. Set the Model 437A/437ASU RF Unit controls as follows:

Preset M1: NORMAL

SYM SWEEP WIDTH: cw

SYM SWEEP WIDTH VARIABLE: cw

RF ON/OFF: ON

d. Turn the 430 Mainframe power ON.

e. Tune the frequency meter to make its dip coincident with each marker pip.

f. Observe that the frequency indicator (M1 and M2) and the frequency meter indications fall within the frequency accuracy limits of ±1%. If they do not, refer to the calibration procedure in paragraph 5.4.

5.3.2 SYMMETRICAL SWEEP WIDTH ACCURACY

a. Connect the equipment as shown in Figure 5-1.

b. Set the SWEEP FUNCTION to SYM M1 with M1 at 33 GHz. Set the Model 437A SYM SWEEP WIDTH switch ccw.

c. Set the frequency meter to 33 GHz and center the oscilloscope display by adjusting M1 if necessary.

d. Tune the frequency meter until the peak of the display is at the right side of the trace and note the frequency.

e. Tune the frequency meter until the peak of the display is at the left side of the trace and note the frequency.

f. The difference between the two frequencies should be equal to the frequency setting of the SYM SWEEP WIDTH switch ±1% of the total band plus ±2% of the switch setting.

g. Repeat paragraph 5.3.2d, e & f for each switch position.

h. With the SYM SWEEP WIDTH switch fully cw, turn the VARIABLE control through its range (0-13.5 GHz) and observe that the RF display varies accordingly.

5.3.3 PRESET M1 TEST

NOTE

Preset M1 cable, P/N C139-807, must be connected to perform the preset M1 Test.

a. Connect equipment as shown in Figure 5-1.

b. Set Model 437A SWEEP FUNCTION to SYM M1 with M1 at center scale. Set the Model 437A SYM SWEEP WIDTH switch and Variable control fully cw.

c. Set Model 437A PRESET M1-NORMAL switch 1 to trhe PRESET position.

d. Vary the M1 control. It should have no effect on the RF display.

e. Adjust the PRESET M1 control 1 fully ccw and note that the RF display shifts accordingly.

f. Set the Model 430 SWEEP FUNCTION to CW M1.

g. Adjust Model 437A PRESET M1 control 1 through its range and note that the RF dot moves smoothly across the oscilloscope.

h. Repeat steps 5.3.3b through f for PRESET M1-NORMAL switches 2 and 3.

i. Return all PRESET M1-NORMAL switches to NORMAL.

5.3.4 FM PHASING TEST.

a. Connect equipment as shown in Figure 5-1.

b. Set the 430 Mainframe controls as follows:

SWEEP FUNCTION: SYM M1	SWEEP TIME (SEC): MAN
M1: 33 GHz	SWEEP RESPONSE TIME: FAST

c. Set the Model 437A SYM SWEEP WIDTH switch ccw.

d. Trigger the oscilloscope internally.

e. Apply a 200 Hz square wave at 100 mv peak-to-peak to the FM input connector on the rear of the Model 437A RF Source Control Unit.

f. Tune the wavemeter about the 33 GHz setting and observe the 200 Hz square wave phasing to be correct as shown below:

CORRECT

INCORRECT

g. Set Model 430 SWEEP RESPONSE TIME switch to AUTO.

h. The presentation should change to a differentiated waveform.

i. Disconnect the signal from the FM input.

5.3.5 PROPORTIONAL OUTPUT TEST

a. Set the Model 430 SWEEP FUNCTION to F1-F2 with F1 and F2 at the nominal low and high ends, respectively, of the band.

b. Set the SWEEP TIME (SEC) and SWEEP TIME (SEC) VARIABLE controls fully cw.

c. Connect the 430 Mainframe PROPORTIONAL OUTPUT to the oscilloscope.

d. There should be a +1, ±1 volt to +20.4, ±3 volt ramp.

e. Set the PROPORTIONAL OUTPUT switch to 10V/BAND.

f. The ramp should decrease to 0, ±0.25 volt to +9.75, ±0.25 volts.

g. Disconnect the PROPORTIONAL OUTPUT from the oscilloscope.

5.3.6 POWER OUTPUT TEST

a. Connect the equipment as shown in Figure 5-2.

b. Set Model 430 SWEEP FUNCTION to CW M1 with M1 at 26.5 GHz.

c. While observing the power meter rotate the M1 control across the band noting that the minimum power does not fall below specifications. (See Table 1-3.)

d. Set M1 at the maximum power point and adjust the variable attenuator for .2 dB less than 1 mW.

CAUTION

DO NOT APPLY MORE THAN 1 mW OF POWER TO THE MIXER.

5.3.7 FM RESPONSE TEST

a. Connect the equipment as shown in Figure 5-3.

b. Set Model 430 controls as follows:

SWEEP FUNCTION: SYM M1	TRIGGER: AUTO
SWEEP TIME (SEC): MAN	SWEEP RESPONSE TIME: FAST
M1: Center Scale	

c. Set Model 437A SYM SWEEP WIDTH switch ccw.

d. Adjust the spectrum analyzer controls for a peak amplitude signal with the Scan Width/Div control of the analyzer set at 5 MHz or 10 MHz.

e. Apply a 135 mV peak-to-peak sinewave at 200 Hz to the FM input connector J3 on the rear of the Model 437A RF source Control Unit.

f. Note that the peak-to-peak deviation of the spectrum analyzer signal remains between 15.9 MHz and 25.2 MHz.

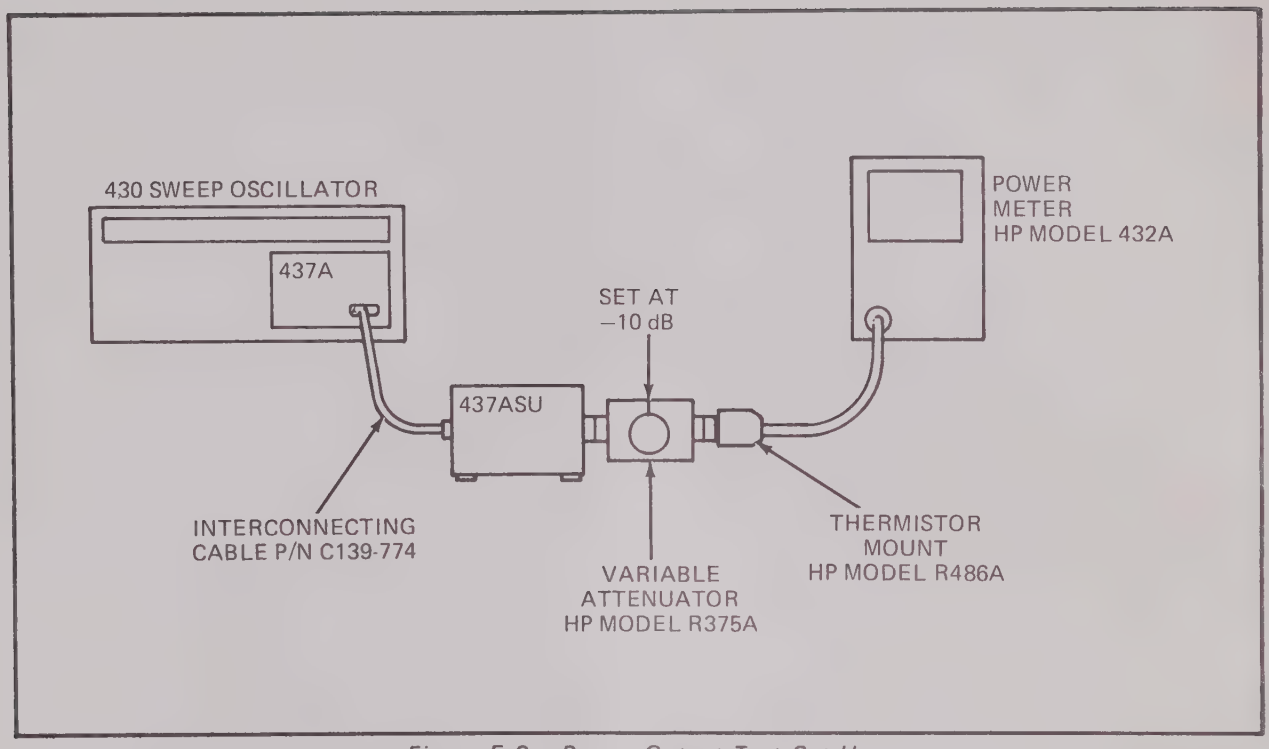


Figure 5-2. Power Output Test Set-Up

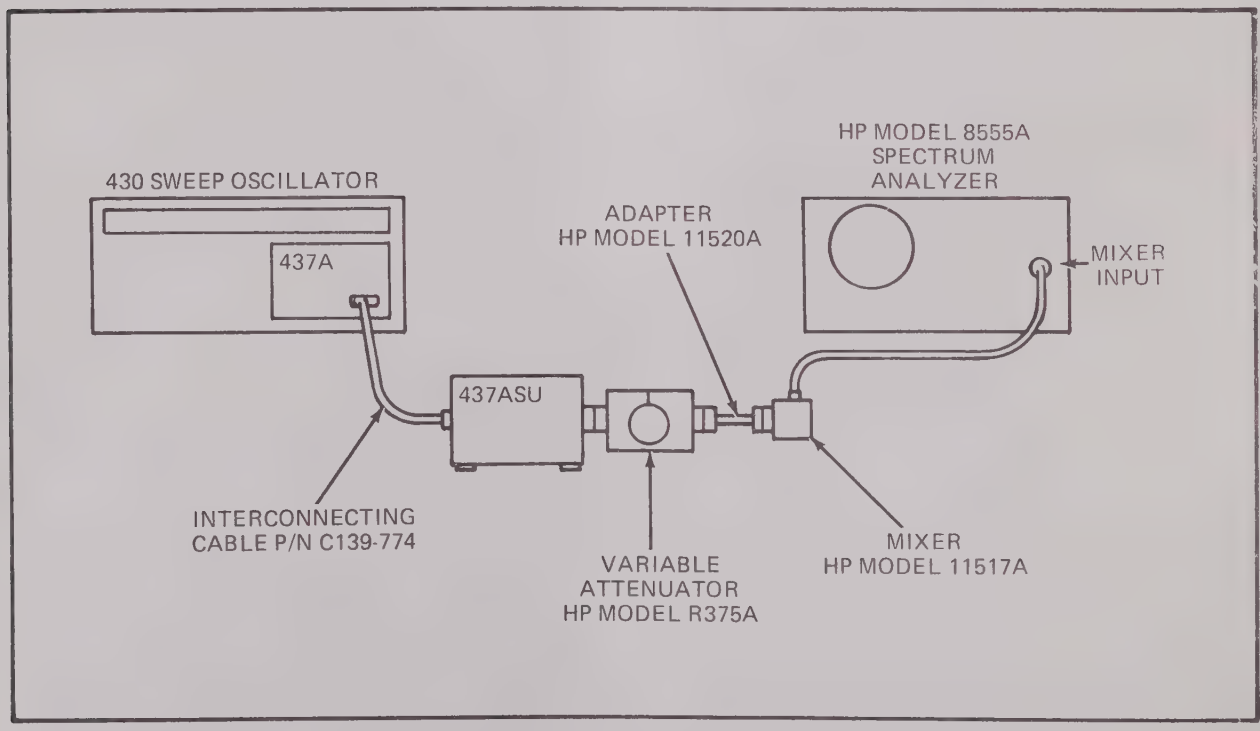


Figure 5-3. FM Response & Residual FM Test Set-Up.

g. Vary the signal generator input frequency from minimum to 100 KHz and note that the FM response remains within specifications.

h. Disconnect the input at the FM connector.

5.3.8 10% CHANGE IN LINE VOLTAGE

a. Connect the equipment as shown in Figure 5-3.

b. Set the Scan Width/Div of the spectrum analyzer to 50 KHz and obtain a stable presentation.

c. Vary the line voltage from 105 volts to 125 volts and note that the frequency shift is less than 100 KHz. Return the line voltage to 115 volts.

5.3.9 PEAK RESIDUAL FM TEST

a. Connect the equipment as shown in Figure 5-3 and apply line voltage through a variable transformer to the 430A Sweep Oscillator.

b. Set the Model 430 Mainframe controls as follows:

SWEEP FUNCTION: SYM M1	SWEEP TIME (SEC): MAN
M1: Center Scale	SWEEP RESPONSE TIME: AUTO

c. Set the Model 437A SYM SWEEP WIDTH switch ccw.

d. Measure the peak residual FM. It should be 60 KHz or less.

e. Turn the Model 430 Mainframe power OFF.

5.3.10 RESIDUAL FM (ALTERNATE METHOD)

a. Connect the equipment as shown in Figure 5-1.

b. Set the Model 430 controls as specified in paragraph 5.3.7, step b.

c. Calibrate the frequency meter as a function discriminator as follows: Tune the frequency meter so that its dip is entered in the oscilloscope display as shown in Figure 5-4. Place a straight edge on the display and measure the maximum slope of the frequency meter dip. Divide the vertical measurement to obtain the discriminator constant in millivolts/KHz.

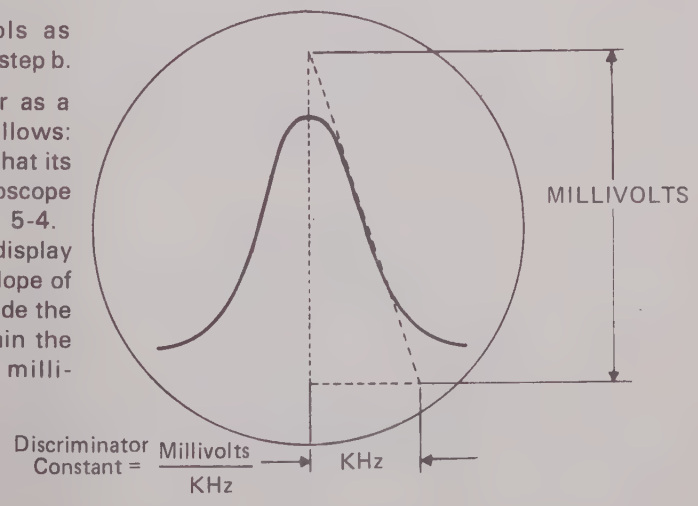


Figure 5-4. Slope Discriminator Display.

d. Set the SWEEP FUNCTION switch to SYM M1.

e. Set the SWEEP TIME (SEC) switch to MAN and rotate the VARIABLE (vernier) control fully counterclockwise.

f. Rotate Model 437A SYMMETRICAL SWEEP WIDTH control fully counterclockwise for narrowest sweep width.

g. Increase the oscilloscope vertical sensitivity and tune the frequency meter for maximum peak-to-peak vertical amplitude. The oscilloscope time base should be used. Record the peak-to-peak amplitude.

h. Divide the peak-to-peak amplitude figure by the discriminator constant to obtain KHz peak-to-peak. Then divide by 2 to obtain peak residual FM. This should not exceed the specification for the RF Unit being used.

NOTE

To ensure that the auto bandwidth circuitry is functioning properly, place the SWEEP RESPONSE TIME slide switch (on rear panel) to FAST. The residual FM should increase. Then set the switch back to AUTO. Within a few seconds, the residual FM should decrease to its minimum value indicating that the bandwidth has been reduced.

5.4 CALIBRATION PROCEDURE

a. Connect the equipment as shown in Figure 5-5.

b. Set Model 430 Mainframe controls as follows:

Front Panel

SWEEP FUNCTION: F1-F2	TRIGGER: AUTO
SWEEP TIME (SEC): .01	SWEEP TIME (SEC) VARIABLE: ccw
F1: Low Mechanical Limit	F2: High Mechanical Limit
M1: Nominal Low End of Band	M2: Nominal High End of Band
MARKER AMPLITUDE: Center	1 KHz ⊓⊔ :OFF

Rear Panel

RF MARKER: ON	SWEEP RESPONSE TIME: AUTO
RF DURING RETRACE: OFF	SYM MARKERS: CALIBRATED
JUMPER SWITCH: OFF	PROPORTIONAL OUTPUT: 40V/OCTAVE

c. Set the frequency meter at 26.5 GHz.

d. Adjust A2R31 until the frequency meter pip is coincident with the M1 marker dip. See Figure 5-6 for pot. location.

e. Set the frequency meter at 40 GHz

f. Adjust A2R104 until the frequency meter pip is coincident with the M2 marker dip Repeat steps d and f as necessary to achieve frequency accuracy

g. Set the frequency meter at 40 GHz.

h. Turn the SWEEP TIME Variable fully cw.

i. Adjust A2R50 if required to bring the frequency meter pip and the M2 marker into coincidence

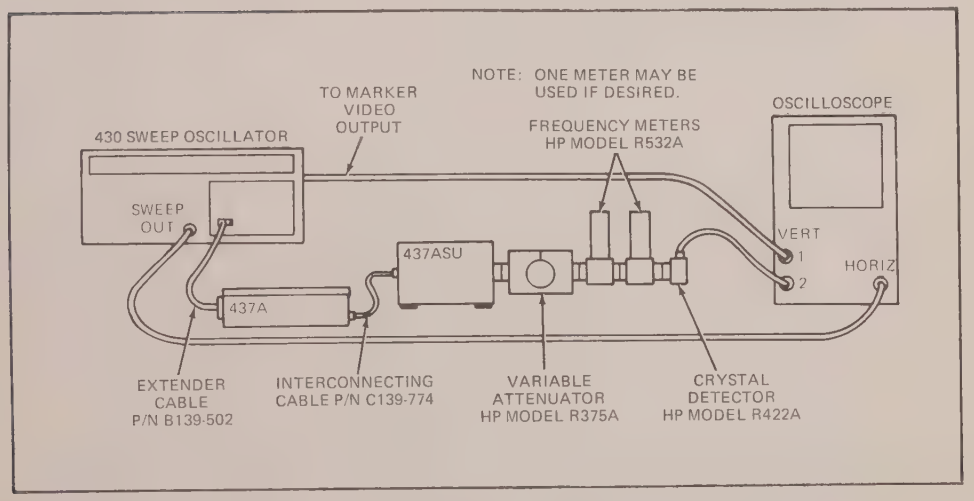


Figure 5-5. Calibration Procedure Test Set-Up.

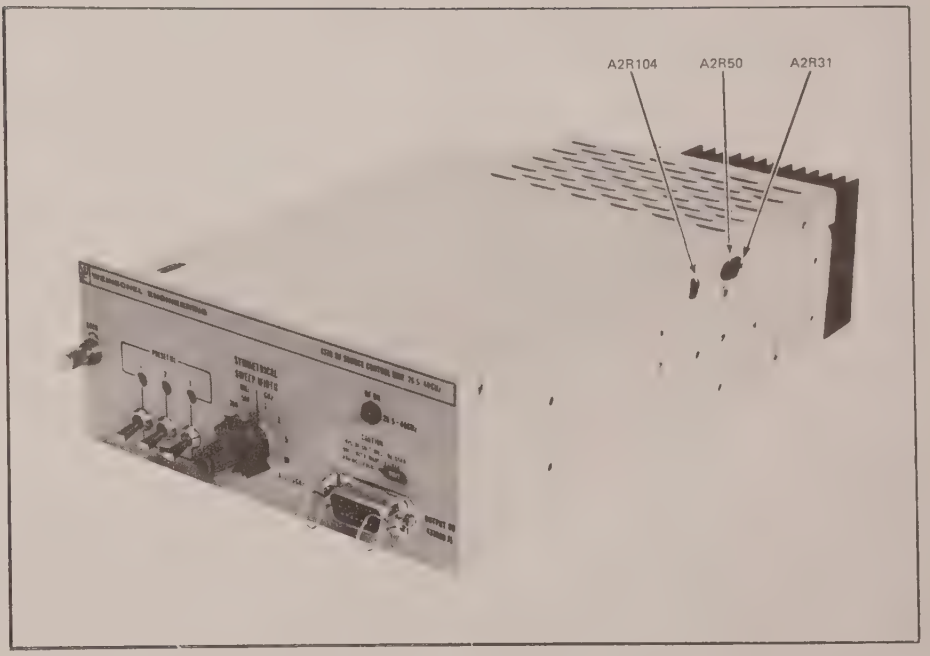


Figure 5-6. Model 437A External Calibration Controls.

SECTION 6
REPLACEABLE PARTS

6.1 INTRODUCTION

This section provides information for procuring replaceable parts for the Model 437A/437ASU RF Unit. The parts listed include all parts subject to burnout, breakage or deterioration during normal operation of the equipment. Resistors and capacitors, particularily for "Select at Test" components, may be used in combination (series, parallel, or both) to obtain the required fixed value, or may not be used if necessary to obtain required test results..

6.2 REFERENCE DESIGNATIONS

All reference designations for electrical parts are preceded by a prefix which indicates the assembly in which the part is contained. Table 6-1 and Figure 6-1, and Table 6-8 and Figure 6-8 identifies, and locates, each assembly by name and reference designation.

6.3 ORDERING INFORMATION

The following information should be included when ordering replacement parts.

a. Weinschel Engineering part number and description of part.

b. The instruments model number and serial number.

c. If ordering a part not included in the replaceable parts list, include a complete description of part, its functions and its location within the equipment.

d. 1N914 and 1N3064 diodes are interchangeable; either may be listed in the parts lists.

6.4 PARTS LIST

A list of parts for each unit and assembly is provided in Tables 6-1 through 6-8.

Component location drawings (Figures 6-1 through 6-8) are provided adjacent to their applicable parts list.

6.5 MANUFACTURER CODES

The manufacturer codes are identified in Appendix A of this manual.

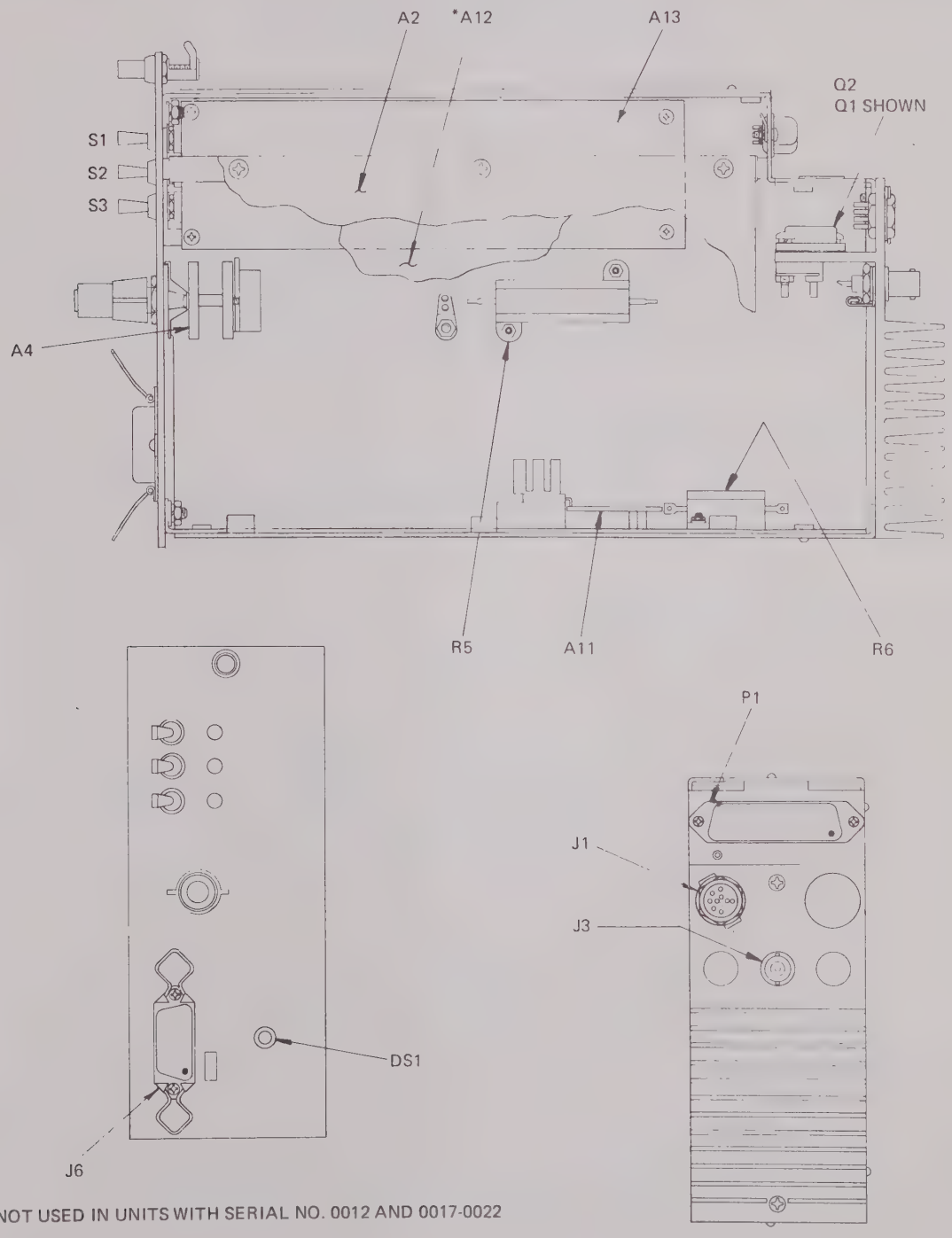


Figure 6-1. Model 437A, Main Assembly.

TABLE 6-1. MODEL 437A, MAIN ASSEMBLY PARTS LIST

Ref. Des.	Description	HP Part Number	Mfr Part Number	Mfr Code
	Model 437A Main Assembly	139-802	139-802	93459
A2	Tuning & Bias Supply Assembly	D139-109-24	D139-109-24	93459
A4	Symmetrical Sweep Switch Assembly	D139-794	D139-794	93459
A11	Heat Exchanger Assembly	B139-316-4	B139-316-4	93459
A12[1]	Auxiliary Board Assembly	C139-559	C139-559	93459
A13[2]	Crowbar & Preset MI Control Assembly	D139-796	D139-796	93459
DS1	LED	12-91	5082-4403	50434
J1	Connector, Receptacle	62-76	126-221-1000	13511
J2	Connector, Receptacle BNC	63-5	4760-3	
J3	Connector, 14 Pin	62-138	57-40140	13511
Q1	Transistor, PNP	12-177	MJ-900	04713
Q2	Transistor, NPN	12-178	MJ-1000	04713
R5	Resistor, 7.5 ohm, 1%, 50W	26-92-7R5	RH-50-7R5	91637
R6	Resistor, W W, 15 ohm, 5%, 25W	26-8-15	RH-25-15	91637
S1	Switch, Toggle	55-67	7201-P3BE	09353
S2	Switch, Toggle	55-67	7201-P3BE	09353
S3	Switch, Toggle	55-67	7201-P3BE	09353

[1] Used in units with serial numbers 0013-0016 and 0023 and up.
[2] Referred to as the Auxiliary Board Assembly for units with serial numbers 0012 through 0022.

Figure 6-2A. Assembly A2, Tuning and Bias Supply, Component Location (Serial No. 0012 thru 0022)

Figure 6-2B. Assembly A2, Tuning and Bias Supply Component Locations (Serial No. 0023 and up)

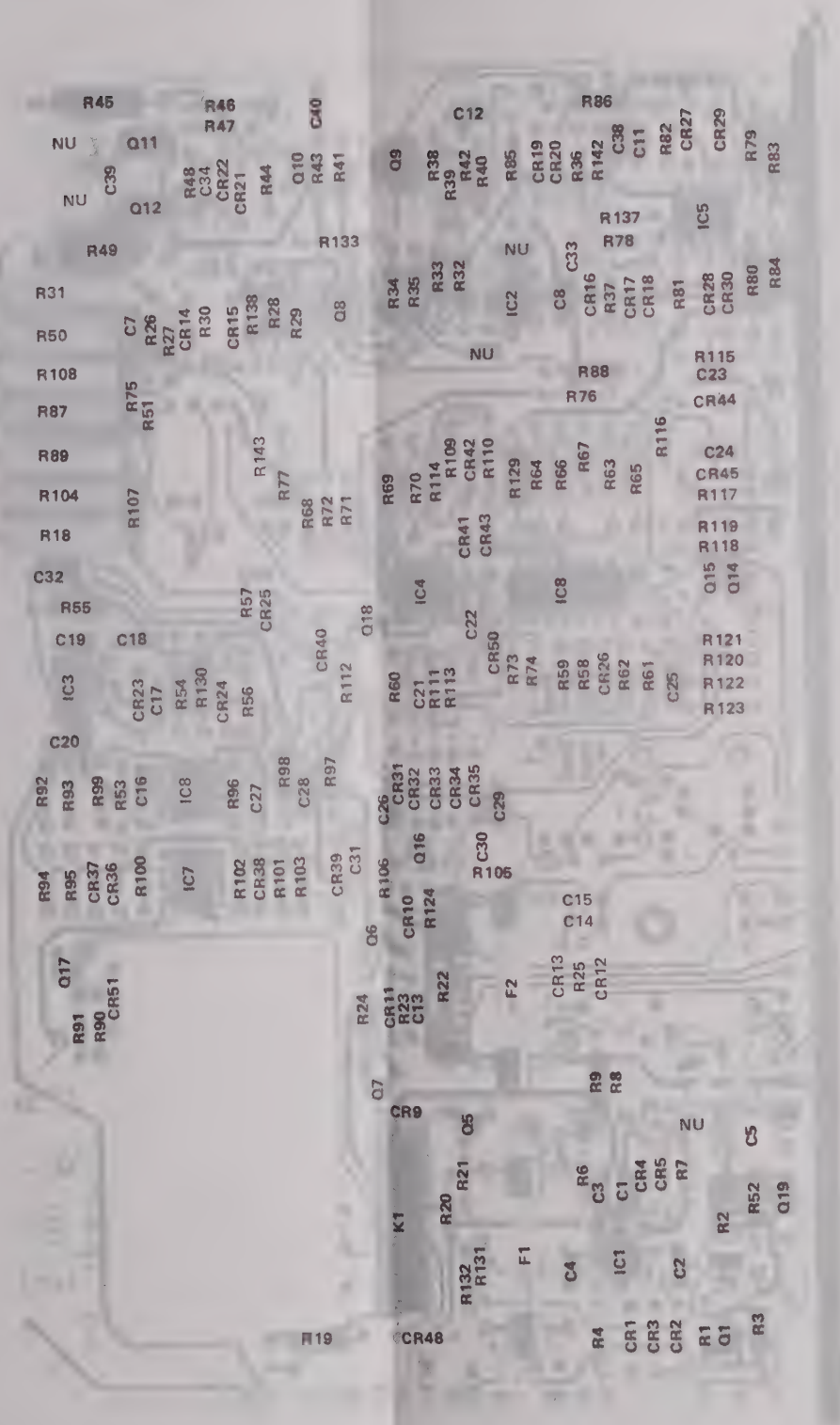


Figure 6-2A. Assembly A2, Tuning and Bias Supply, Component Location (Serial No. 0012 thru 0022)

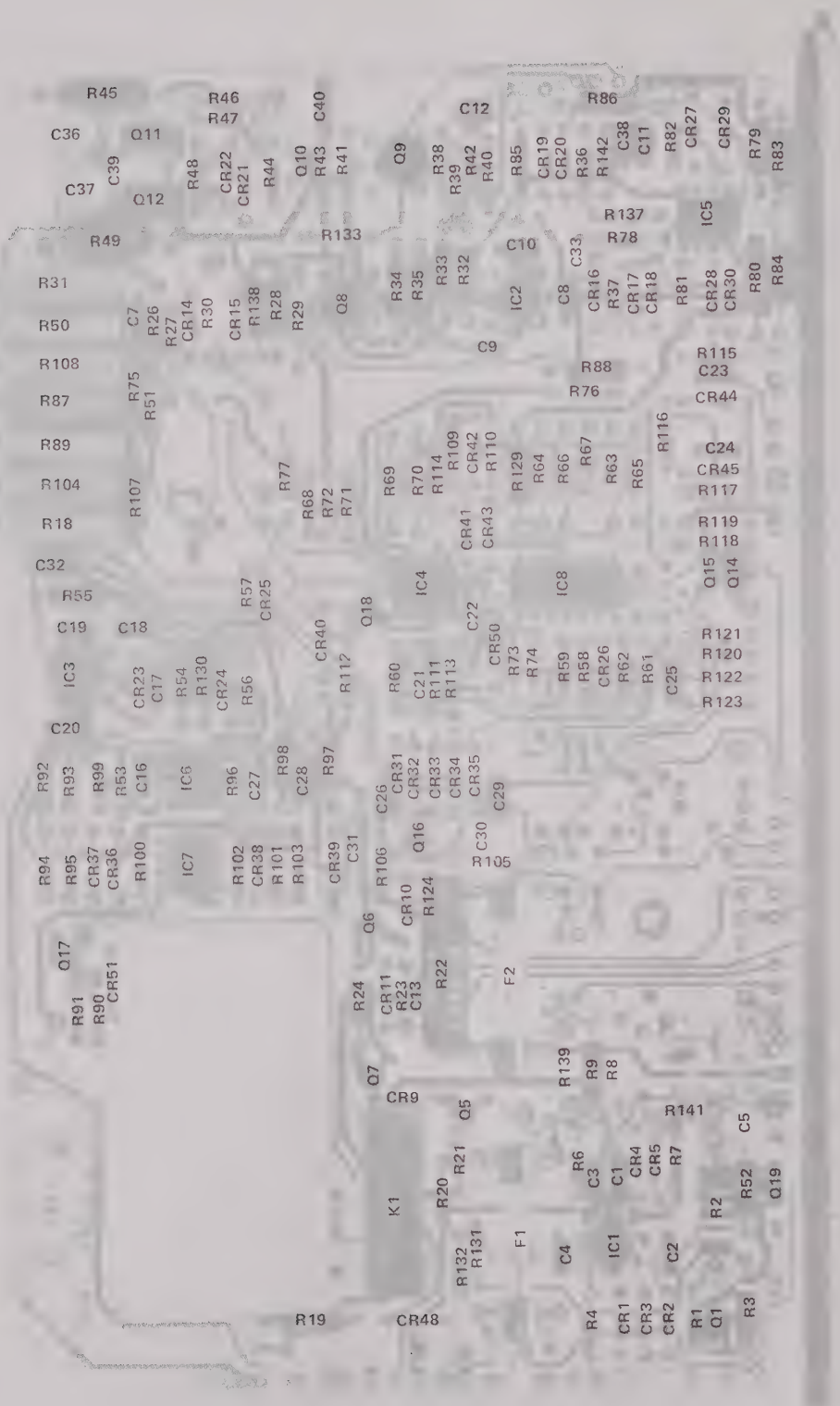


Figure 6-2B. Assembly A2, Tuning and Bias Supply Component Locations (Serial No. 0023 and up)

TABLE 6-2. ASSEMBLY A2, TUNING AND BIAS SUPPLY PARTS LIST

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
A2	Tuning and Bias Supply Assembly	D139-109-24	D139-109-24	93459
C1	Capacitor, cer, 2200pF, 10%, 100V	34-27-222	CK05BX222K	81349
C2	Capacitor, cer, 150pF, 10%, 200V	34-27-151	CK05BX151K	81349
C3	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349
C4	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349
C5	Capacitor, tant, 10uF, 10%, 35V	31-80	T362C106M035AS	31433
C6	Not Used			
C7	Capacitor, cer, 2200pF, 10%, 100V	34-27-222	CK05BX222K	81349
C8	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349
C9	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349
C9[1]	Not Used			
C10	Capacitor, cer, 3300pF, 10%, 100V	34-27-332	CK05BX332K	81349
C10[1]	Not Used			
C11	Capacitor, cer, 0.047uF, 10%, 100V	34-28-473	CK06BX473K	81349
C12	Capacitor, cer, 330pF, 10%, 200V	34-27-331	CK05BX331K	81349
C12[1]	Capacitor, cer, 2200 pF, 10%, 100V	34-27-222	CK05BX222K	81349
C13	Capacitor, cer, 3300pF, 10%, 100V	34-27-332	CK05BX332K	81349
C14	Not Used			
C14[1]	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349
C15	Not Used			
C15[1]	Capacitor, cer, 0.22uF, 20%, 50V	34-23-R22	7CZ5U223X0050D1	56289
C16	Capacitor, cer, 6800pF, 10%, 100V	34-27-682	CK05BX682K	81349
C17	Capacitor, cer, 68pF, 10%, 200V	34-27-680	CK05BX680K	81349
C18	Capacitor, cer, 0.1uF, 10%, 100V	34-28-104	CK06BX104K	81349
C19	Capacitor, cer, 150pF, 10%, 200V	34-27-151	CK05BX151K	81349
C20	Capacitor, cer, 0.1uF, 10%, 100V	34-28-104	CK06BX104K	81349
C21	Capacitor, cer, 0.47uF, 20%, 50V	34-23-R47	7CZ5U474X0050E1	56289
C22	Capacitor, cer, 0.33uF, 20%, 50V	34-23-R33	7CZ5U333X0050D1	56289
C23	Capacitor, cer, 1000pF, 10%, 200V	34-27-102	CK05BX102K	81349
C24	Capacitor, cer, 1000pF, 10%, 200V	34-27-102	CK05BX102K	81349
C25	Capacitor, cer, 0.1uF, 10%, 100V	34-28-104	CK06BX104K	81349
C26	Capacitor, cer, 470pF, 10%, 200V	34-27-471	CK05BX471K	81349
C27	Capacitor, cer, 2.2uF, 20%, 50V	34-23-2R2	7CZ5U225X0050E4	56289
C28	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349
C29	Capacitor, cer, 6800pF, 10%, 100V	34-27-682	CK05BX682K	81349
C30	Capacitor, tant, 10uF, 10%, 35V	31-80	T362C106M035AS	31433
C31	Capacitor, cer, 0.47uF, 20%, 50V	34-23-R47	7CZ5U474X0050E1	56289
C32	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349
C33	Capacitor, cer, 680pF, 10%, 200V	34-27-681	CK05BX681K	81349
C34	Not Used			
C34[1]	Capacitor, cer, 370pF, 10%, 200V	34-27-331	CK05BX331K	81349
C35	Not Used			
C36	Capacitor, tant, 100uF, 20%, 20V	31-76	T362D107M020AS	31433
C36[1]	Not Used			
C37	Capacitor, tant, 100uF, 20%, 20V	31-76	T362D107M020AS	31433
C37[1]	Not Used			
C38	Capacitor, cer, 330pF, 10%, 200V	34-27-331	CK05BX331K	81349
C39	Capacitor, cer, 680pF, 10%, 200V	34-27-681	CK05BX681K	81349
C40	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349

[1] Units with serial numbers 0012 through 0022.

TABLE 6-2. ASSEMBLY A2, TUNING AND BIAS SUPPLY PARTS LIST (Cont.)

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
CR1	Diode	12-99	1N483B	80131
CR2	Diode	12-99	1N483B	80131
CR3	Diode	12-99	1N483B	80131
CR4	Diode	12-99	1N483B	80131
CR5	Diode	12-99	1N483B	80131
CR6	Not Used			80131
CR7	Not Used			80131
CR8	Not Used			80131
CR9	Diode	12-99	1N483B	80131
CR10	Diode	12-99	1N483B	80131
CR11	Diode	12-99	1N483B	80131
CR12	Not Used			80131
CR12[1]	Diode, Rectifier	12-110	1N4383	80131
CR13	Not Used			80131
CR13[1]	Diode, Zener, 15V	12-196	1N4744A	80131
CR14	Diode	12-99	1N483B	80131
CR15	Diode	12-99	1N483B	80131
CR16	Diode	12-99	1N483B	80131
CR17	Diode	12-99	1N483B	80131
CR18	Diode	12-99	1N483B	80131
CR19	Diode	12-99	1N483B	80131
CR20	Diode	12-99	1N483B	80131
CR21	Diode	12-99	1N483B	80131
CR22	Diode	12-99	1N483B	80131
CR23	Diode	12-99	1N483B	80131
CR24	Diode	12-99	1N483B	80131
CR25	Diode	12-99	1N483B	80131
CR26	Diode	12-99	1N483B	80131
CR27	Diode	12-99	1N483B	80131
CR28	Diode	12-99	1N483B	80131
CR29	Diode	12-99	1N483B	80131
CR30	Diode	12-99	1N483B	80131
CR31	Diode	12-99	1N483B	80131
CR32	Diode	12-99	1N483B	80131
CR33	Diode	12-99	1N483B	80131
CR34	Diode	12-99	1N483B	80131
CR35	Diode, Zener, 8.2V	12-134	1N756A	80131
CR36	Diode	12-99	1N483B	80131
CR37	Diode	12-99	1N483B	80131
CR38	Diode	12-99	1N483B	80131
CR39	Diode	12-99	1N483B	80131
CR40	Diode	12-99	1N483B	80131
CR41	Diode	12-99	1N483B	80131
CR42	Diode	12-99	1N483B	80131
CR43	Diode	12-99	1N483B	80131
CR44	Diode	12-99	1N483B	80131
CR45	Diode	12-99	1N483B	80131
CR46	Not Used			
CR47	Not Used			
CR48	Diode	12-51	1N3064	80131
CR49	Not Used			
CR50	Diode	12-45	1N250	80131
CR51	Diode	12-51	1N3064	80131

[1] Units with serial numbers 0012 through 0022.

TABLE 6-2. ASSEMBLY A2, TUNING AND BIAS SUPPLY PARTS LIST (Cont.)

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
F1	Fuse, 1½ SB Amp	52-1-1½		
F2	Fuse, 1½ SB Amp	52-1-1½		
IC1	I C, Op Amp	12-165	LM301AH	27014
IC2	I C, Op Amp	12-165	LM301AH	27014
IC3	I C, Op Amp	12-165	LM301AH	27014
IC4	I C, Op Amp, Dual Input	12-192	MC1458P	04713
IC5	I C, Op Amp, Dual Input	12-192	MC1458P	04713
IC6	I C, Op Amp, Dual Input	12-192	MC1458P	04713
IC7	I C, Op Amp, Dual Input	12-192	MC1458P	04713
IC8[3]	Transistor Array	12-172	MC3346P	04713
K1	Relay	47-34	MRB1A05	71482
Q1	Transistor, PNP	12-140	2N4403	80131
Q2	Not Used			
Q3	Not Used			
Q4	Not Used			
Q5	Transistor, NPN	12-139	2N4401	80131
Q6	Transistor, PNP	12-140	2N4403	80131
Q7	Transistor, PNP	12-140	2N4403	80131
Q8	Transistor, NPN, Dual	12-222	2N4045	80131
Q9	Transistor, NPN, Dual	12-222	2N4045	80131
Q10	Transistor, PNP	12-140	2N4403	80131
Q11	Transistor, NPN	12-206	MPS-U05	04713
Q12	Transistor, PNP	12-194	MPS-U55	04713
Q13	Not Used			
Q14	Transistor, NPN	12-139	2N4401	80131
Q15	Transistor, NPN	12-139	2N4401	80131
Q16	Transistor, FET	12-202	2N4092	80131
Q17	Transistor, PNP	12-140	2N4403	80131
Q18	Transistor, PNP	12-140	2N4403	80131
Q19	Transistor, PNP	12-140	2N4403	80131
R1	Resistor, carb, 82 ohm, 5%, ¼W	25-25-82	RC07GF820J	81349
R2	Resistor, WW, 0.68 ohm, 5%, 2W	26-20-R68	BWH-0.68	91637
R2[1]	Resistor, WW, 1 ohm, 5%, 2W	26-20-1	BWH-1.0	91637
R3	Resistor, comp, 1K, 5%, ½W	25-8-1000	RC20GF102J	81349
R4	Resistor, carb, 180 ohm, 5%, ¼W	25-25-180	RC07GF181J	81349
R5	Not Used			
R6	Resistor, carb, 15K, 5%, ¼W	25-25-15K	RC07GF153J	81349
R7	Resistor, carb, 22K, 5%, ¼W	25-25-22K	RC07GF223J	81349
R8[2]	Resistor, film, (selected), 1%, 1/8W	25-20	RN60C	81349
R9	Resistor, film, 1.96K, 1%, 1/8W	25-20-1960	RN60C1961F	81349
R10	Not Used			
R11	Not Used			
R12	Not Used			
R13	Not Used			
R14	Not Used			
R15	Not Used			
R16	Not Used			
R17	Not Used			
R18	Resistor, var, 2K	20-203-202	3009P-1-202	32997
R19	Resistor, film, 12.1K, 1%, 1/8W	25-20-12R1K	RN60C1212F	81349

[1] Units with serial numbers 0023 through 0022.
[2] Value is selected at test.
[3] In some units IC8 may be Mfr. Part No.: CA3046, Mfr. Code: 86684. Type MC3346 and type CA3046 ICs are interchangeable.

TABLE 6-2. ASSEMBLY A2, TUNING AND BIAS SUPPLY PARTS LIST (Cont.)

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
R20	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R21	Resistor, carb, 470 ohm, 5%, ¼W	25-25-470	RC07GF471J	81349
R22	Resistor, WW, 1.4 ohm, 1%, 5W	26-29-1R40	RW79U1R40F	91637
R23	Resistor, carb, 470 ohm, 5%, ¼W	25-25-470	RC07GF471J	81349
R24	Resistor, film, 1.8K, 5%, ½W	25-8-1800	RC20GF182J	81349
R25	Not Used			
R25[1]	Resistor, carb, 3.9K, 5%, ¼W	25-25-3900	RC07GF392J	81349
R26	Resistor, carb, 51K, 5%, ¼W	25-25-51K	RC07GF513J	81349
R27	Resistor, carb, 51K, 5%, ¼W	25-25-51K	RC07GF513J	81349
R28	Resistor, film, 10K, 1%, 1/8W	25-20-10K	RN60C1002F	81349
R29	Resistor, film, 10K, 0.1%, 1/8W	25-23-10K	RN60E1002B	81349
R30[2]	Resistor, carb, (selected), 1%, 1/8W	25-28	RN60E	81349
R31	Resistor, var, 500 ohm	20-203-501	3009P-1-501	32997
R32	Resistor, film, 1M, 1%, 1/8W	25-20-1M	RN60C1004F	81349
R33	Resistor, film, 1M, 1%, 1/8W	25-20-1M	RN60C1004F	81349
R34	Resistor, film, 750K, 1%, 1/8W	25-20-750K	RN60C7503F	81349
R35	Resistor, film, 1.3K, 1%, 1/8W	25-20-1300	RN60C1301F	81349
R36	Resistor, carb, 5.1K, 5%, ¼W	25-25-5100	RC07GF512J	81349
R37	Resistor, carb, 2K, 5%, ¼W	25-25-2000	RC07GF202J	81349
R38	Resistor, carb, 3.3K, 5%, ¼W	25-25-3300	RC07GF332J	81349
R39	Resistor, carb, 3.3K, 5%, ¼W	25-25-3300	RC07GF332J	81349
R40	Resistor, carb, 100K, 5%, ¼W	25-25-100K	RC07GF104J	81349
R40[1]	Resistor, carb, 12K, 5%, ¼W	25-25-12K	RC07GF123J	81349
R41	Resistor, carb, 15K, 5%, ¼W	25-25-15K	RC07GF153J	81349
R42	Resistor, carb, 200 ohm, 5%, ¼W	25-25-200	RC07GF201J	81349
R43	Resistor, carb, 180K, 5%, ¼W	25-25-180K	RC07GF184J	81349
R43[1]	Resistor, carb, 10K, 5%, ¼W	25-25-10K	RC07GF103J	81349
R44	Resistor, carb, 150 ohm, 5%, ¼W	25-25-150	RC07GF151J	81349
R45	Resistor, WW, 78.7 ohm, 1%, 3W	26-30-78R7	RS-213	91637
R45[1]	Resistor, comp, 47 ohm, 5%, 1W	25-9-47	RC32GF470J	81349
R46	Resistor, carb, 10 ohm, 5%, ¼W	25-25-10	RC07GF100J	81349
R47	Resistor, carb, 10 ohm, 5%, ¼W	25-25-10	RC07GF100J	81349
R48	Resistor, carb, 2.2K, 5%, ¼W	25-25-2200	RC07GF222J	81349
R49	Resistor, WW, 78.7 ohm, 1%, 3W	26-30-78R7	RS-213	91637
R49[1]	Resistor, comp, 47 ohm, 5%, 1W	25-9-47	RC32GF470J	81349
R50	Resistor, var, 500K	20-203-504	3009P-1-504	32997
R51	Resistor, carb, 51K, 5%, ¼W	25-25-51K	RC07GF513J	81349
R52	Resistor, film, 31.6K, 1%, 1/8W	25-20-31R6K	RN60C3162F	81349
R53	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R54	Resistor, film, 475K, 1%, 1/8W	25-20-475K	RN60C4753F	81349
R55	Resistor, film, 475K, 1%, 1/8W	25-20-475K	RN60C4753F	81349
R56	Resistor, carb, 330K, 5%, ¼W	25-25-330K	RC07GF334J	81349
R57	Resistor, carb, 56K, 5%, ¼W	25-25-56K	RC07GF563J	81349
R58	Resistor, carb, 2.2K, 5%, ¼W	25-25-2200	RC07GF222J	81349
R59	Resistor, carb, 150K, 5%, ¼W	25-25-150K	RC07GF154J	81349
R60	Resistor, carb, 390 ohm, 5%, ¼W	25-25-390	RC07GF391J	81349
R61	Resistor, carb, 51K, 5%, ¼W	25-25-51K	RC07GF513J	81349
R61[1]	Resistor, carb, 220K, 5%, ¼W	25-25-220K	RC07GF224J	81349
R62	Resistor, carb, 220 ohm, 5%, ¼W	25-25-220	RC07GF221J	81349
R63	Resistor, film, 2.43K, 0.1%, 1/8W	25-23-2R43K	RN60E2431B	81349
R64	Resistor, film, 2.43K, 0.1%, 1/8W	25-23-2R43K	RN60E2431B	81349
R65	Resistor, film, 100 ohm, 0.1%, 1/8W	25-23-100	RN60E1000B	81349
R66	Resistor, film, 100 ohm, 0.1%, 1/8W	25-23-100	RN60E1000B	81349
R67	Resistor, carb, 220 ohm, 5%, ¼W	25-25-220	RC07GF221J	81349

[1] Units with serial numbers 0012 through 0022.

[2] Value is selected at test.

TABLE 6-2. ASSEMBLY A2, TUNING AND BIAS SUPPLY PARTS LIST (Cont.)

Ref. Des.	Description	₮ Part Number	Mfr. Part Number	Mfr. Code
R68	Resistor, carb, 1.5K, 5%, ¼W	25-25-1500	RC07GF152J	81349
R69	Resistor, film, 243K, 0.1%, 1/8W	25-23-243K	RN60E2433B	81349
R70	Resistor, film, 243K, 0.1%, 1/8W	25-23-243K	RN60E2433B	81349
R71	Resistor, carb, 470 ohm, 5%, ¼W	25-25-470	RC07GF471J	81349
R72	Resistor, carb, 820 ohm, 5%, ¼W	25-25-820	RC07GF821J	81349
R73	Resistor, carb, 2.2K, 5%, ¼W	25-25-2200	RC07GF222J	81349
R74	Resistor, carb, 150K, 5%, ¼W	25-25-150K	RC07GF154J	81349
R75	Resistor, carb, 1.8M, 5%, ¼W	25-25-1R8M	RC07GF185J	81349
R76	Resistor, carb, 390 ohm, 5%, ¼W	25-25-390	RC07GF391J	81349
R77	Resistor, comp, 910 ohm, 5%, ½W	25-8-910	RC20GF911J	81349
R78	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R79	Resistor, film, 221K, 1%, 1/8W	25-20-221K	RN60C2213F	81349
R80	Resistor, film, 221K, 1%, 1/8W	25-20-221K	RN60C2213F	81349
R81	Resistor, carb, 39K, 5%, ¼W	25-25-39K	RC07GF393J	81349
R82	Resistor, carb, 51K, 5%, ¼W	25-25-51K	RC07GF513J	81349
R83	Resistor, film, 68.1K, 1%, 1/8W	25-20-68R1K	RN60C6812F	81349
R84	Resistor, film, 68.1K, 1%, 1/8W	25-20-68R1K	RN60C6812F	81349
R85	Resistor, WW, 8.66 ohm, 1%, 1W	26-67-8R66	RS-1A	91637
R85[1]	Resistor, film, 1.2 ohm, 5%, ½W	25-8-1R2	RC20GF1R2J	81349
R86	Resistor, film, 121K, 1%, 1/8W	25-20-121K	RN60C1213F	81349
R87	Resistor, var, 100K	20-203-104	3009P-1-104	32997
R88	Resistor, film, 150K, 1%, 1/8W	25-20-150K	RN60C1503F	81349
R89	Resistor, var, 200K	20-203-204	3009P-1-204	32997
R90	Resistor, carb, 33K, 5%, ¼W	25-25-33K	RC07GF333J	81349
R91	Resistor, carb, 1.8K, 5%, ¼W	25-25-1800	RC07GF182J	81349
R92	Resistor, carb, 10M, 5%, ¼W	25-25-10M	RC07GF106J	81349
R93	Resistor, carb, 20K, 5%, ¼W	25-25-20K	RC07GF203J	81349
R94	Resistor, carb, 10K, 5%, ¼W	25-25-10K	RC07GF103J	81349
R95	Resistor, carb, 20K, 5%, ¼W	25-25-20K	RC07GF203J	81349
R96	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R97	Resistor, film, 475K, 1%, 1/8W	25-20-475K	RN60C4753F	81349
R98	Resistor, film, 475K, 1%, 1/8W	25-20-475K	RN60C4753F	81349
R99	Resistor, carb, 20K, 5%, ¼W	25-25-20K	RC07GF203J	81349
R100	Resistor, carb, 10K, 5%, ¼W	25-25-10K	RC07GF103J	81349
R101	Resistor, carb, 120K, 5%, ¼W	25-25-120K	RC07GF124J	81349
R102	Resistor, carb, 6.8K, 5%, ¼W	25-25-6800	RC07GF682J	81349
R103	Resistor, carb, 220 ohm, 5%, ¼W	25-25-220	RC07GF221J	81349
R104	Resistor, var, 200 ohm	20-203-201	3009P-1-201	32997
R105[2]	Resistor, film, (selected), 1%, 1/8W	25-28	RN60E	81349
R106	Resistor, carb, 2.2M, 5%, ¼W	25-25-2R2M	RC07GF225J	81349
R107	Resistor, film, 150K, 1%, 1/8W	25-20-150K	RN60C1503F	81349
R108	Resistor, var, 200K	20-203-204	3009P-1-204	32997
R109	Resistor, carb, 47K, 5%, ¼W	25-25-47K	RC07GF473J	81349
R110	Resistor, carb, 330K, 5%, ¼W	25-25-330K	RC07GF334J	81349
R111	Resistor, carb, 68K, 5%, ¼W	25-25-68K	RC07GF683J	81349
R112	Resistor, carb, 22K, 5%, ¼W	25-25-22K	RC07GF223J	81349
R113	Resistor, carb, 100K, 5%, ¼W	25-25-100K	RC07GF104J	81349
R114	Resistor, carb, 7.5K, 5%, ¼W	25-25-7500	RC07GF752J	81349
R115	Resistor, carb, 22K, 5%, ¼W	25-25-22K	RC07GF223J	81349
R116	Resistor, carb, 22K, 5%, ¼W	25-25-22K	RC07GF223J	81349
R117	Resistor, carb, 22K, 5%, ¼W	25-25-22K	RC07GF223J	81349
R118	Resistor, carb, 10K, 5%, ¼W	25-25-10K	RC07GF103J	81349
R119	Resistor, carb, 560K, 5%, ¼W	25-25-560K	RC07GF564J	81349
R120	Resistor, carb, 1.5K, 5%, ¼W	25-25-1500	RC07GF152J	81349

[1] Units with serial numbers 0012 through 0022.
[2] Value is selected at test.

TABLE 6-2. ASSEMBLY A2, TUNING AND BIAS SUPPLY PARTS LIST (Cont.)

Ref. Des.	Description	₮ Part Number	Mfr. Part Number	Mfr Code
R121	Resistor, carb, 3.3K, 5%, ¼W	25-25-3300	RC07GF332J	81349
R122	Resistor, carb, 3.3K, 5%, ¼W	25-25-3300	RC07GF332J	81349
R123	Resistor, carb, 330K, 5%, ¼W	25-25-330K	RC07GF334J	81349
R124	Resistor, carb, 470 ohm, 5%, ¼W	25-25-470	RC07GF471J	81349
R125	Not Used			
R126	Not Used			
R127	Not Used			
R128	Not Used			
R129	Resistor, film, 75K, 1%, 1/8W	25-20-75K	RN60C7502F	81349
R129[1,2]	Resistor, film, (selected), 1%, 1/8W	25-20	RN60C	81349
R130	Resistor, film, 75K, 1%, 1/8W	25-20-75K	RN60C7502F	81349
R130[1,2]	Resistor, film, (selected), 1%, 1/8W	25-20	RN60C	81349
R131	Resistor, carb, 1.8K, 5%, ¼W	25-25-1800	RC07GF182J	81349
R132	Resistor, carb, 7.5K, 5%, ¼W	25-25-7500	RC07GF752J	81349
R133	Resistor, carb, 47K, 5%, ¼W	25-25-47K	RC07GF473J	81349
R134	Not Used			
R135	Not Used			
R136	Not Used			
R137	Resistor, carb, 1.8M, 5%, ¼W	25-25-1R8M	RC07GF185J	81349
R138	Resistor, film, 10K, 1%, 1/8W	25-20-10K	RN60C1002F	81349
R139[2]	Resistor, film, (selected), 1%, 1/8W	25-20	RN60C	81349
R140	Not Used			
R141	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R141[1]	Not Used			
R142	Resistor, carb, 5.1K, 5%, ¼W	25-25-5100	RC07GF512J	81349
R142[1]	Resistor, carb, 51K, 5%, ¼W	25-25-51K	RC07GF513J	81349
R143	Not Used			
R143[1,2]	Resistor, film, (selected), 1%, 0.1W	25-30	RN55C	81349

[1] Units with serial numbers 0012 through 0022.
[2] Value is selected at test.

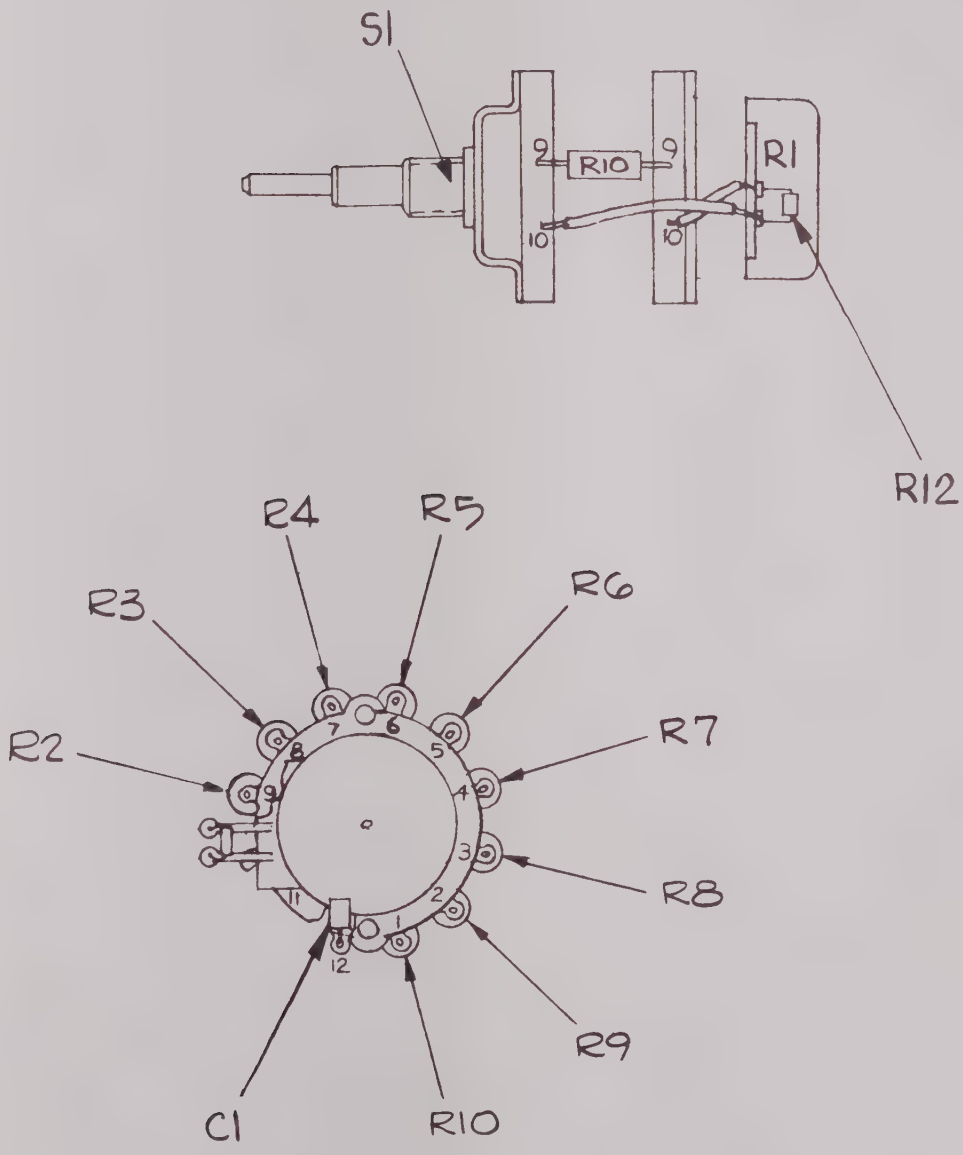
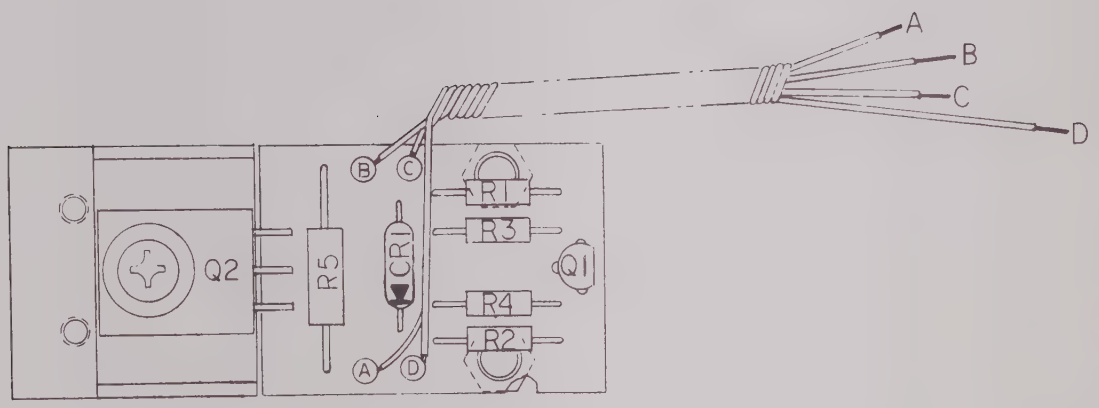


Figure 6-3. Model 437A Assembly A4, Symmetrical Sweep Switch Component Location

TABLE 6-3. ASSEMBLY A4, SYMMETRICAL SWEEP SWITCH PARTS LIST

Ref. Des.	Description	HP Part Number	Mfr. Part Number	Mfr. Code
A4	Symmetrical Sweep Switch Assembly	B139-794	B139-794	93459
C1	Capacitor, 2200pF, 10%, 100V	34-28-222	CK06BX222K	81349
R1	Resistor, var, 10K	P/0B56-72(S1)	B56-72	93459
R2	Resistor, film, 5.23K, 1%, 1/8W	25-20-5230	RN60C5231F	81349
R3	Resistor, film, 2.61K, 1%, 1/8W	25-20-2610	RN60C2611F	81349
R4	Resistor, film, 1.05K, 1%, 1/8W	25-20-1050	RN60C1051F	81349
R5	Resistor, film, 523 ohm, 1%, 1/8W	25-20-523	RN60C5230F	81349
R6	Resistor, film, 261 ohm, 1%, 1/8W	25-20-261	RN60C2610F	81349
R7	Resistor, film, 105 ohm, 1%, 1/8W	25-20-105	RN60C1050F	81349
R8	Resistor, film, 52.3 ohm, 1%, 1/8W	25-20-52R3	RN60C52R3F	81349
R9	Resistor, film, 26.1 ohm, 1%, 1/8W	25-20-26R1	RN60C26R1F	81349
R10	Resistor, film, 10.2 ohm, 1%, 1/8W	25-20-10R2	RN60C10R2F	81349
R11	Not Used			
R12	Resistor, carb, 47K, 5%, ¼W	25-25-47K	RC07GF473J	81349
S1	Switch, Rotary	B56-72	B56-72	93459



WIRE TABLE			
COLOR	WIRE	FROM	TO
W/RED	A	PIN A	Q2 Collector
BLU	B	PIN B	A2-51
VIO	C	PIN C	A13-E5
BLK	D	PIN D	#2 Ground

Figure 6-4. Model 437A, Assembly A11, Heat Exchanger, Component Location

TABLE 6-4. ASSEMBLY A11, HEAT EXCHANGER PARTS LIST

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
A11	Heat Exchanger Assembly	B139-316-4	B139-316-4	93459
CR1	Diode, Zener, 6.2V	12-71	1N753A	80131
R1	Resistor, carb, 6.8K, 5%, ¼W	25-25-6800	RC07GF682J	81349
R2	Resistor, carb, 6.8K, 5%, ¼W	25-25-6800	RC07GF682J	81349
R3	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R4	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R5	Resistor, film, 10 ohm, 5%, 3W	26-79-10	242E-1005	56289
Q1	Transistor, PNP	12-140	2N4403	80131
Q2	Transistor, NPN	12-186	MJE6044	04713

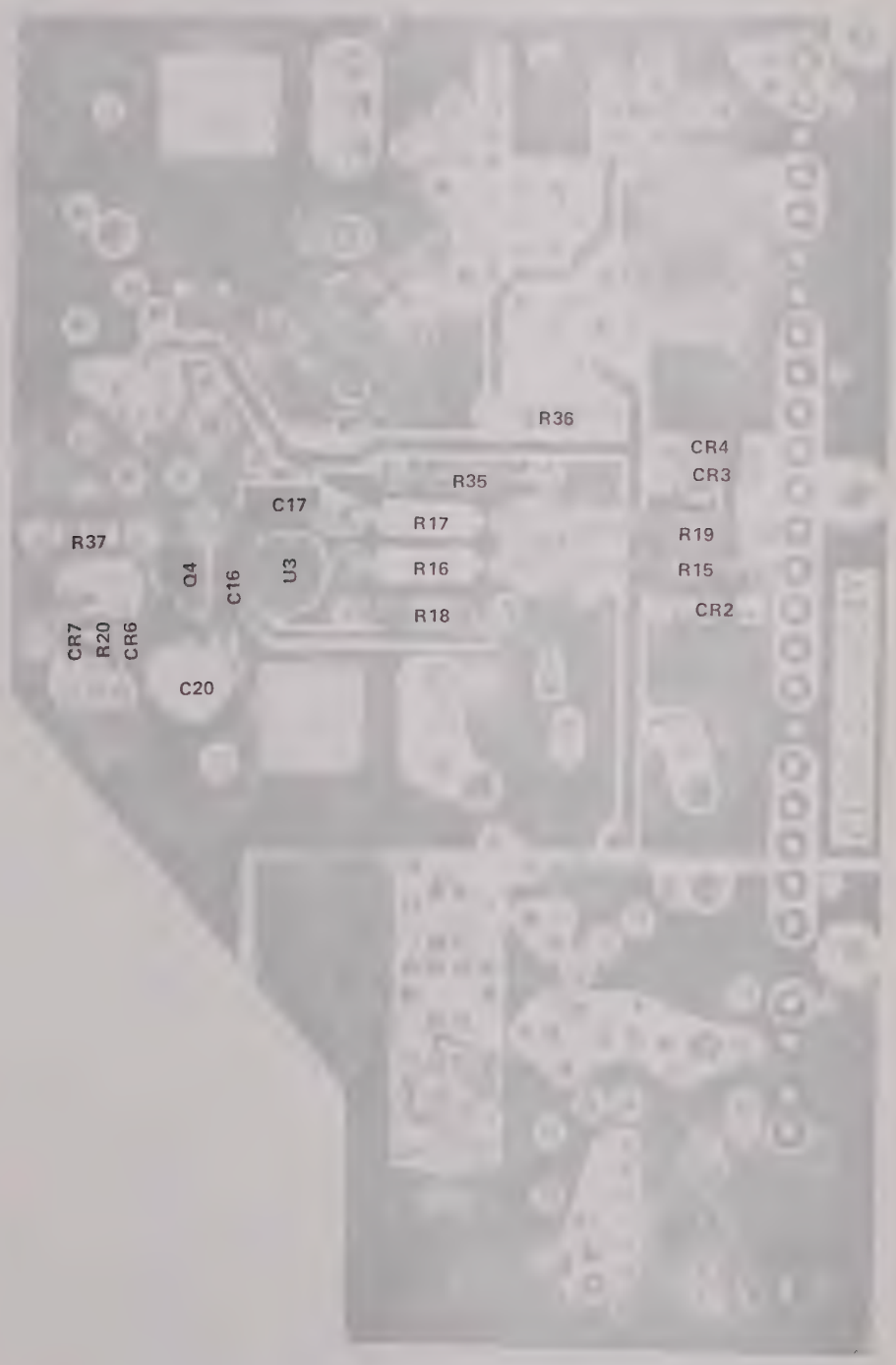


Figure 6-5. Model 437A, Assembly A12, Auxiliary Board, Component Location (Serial No. 0013 thru 0016, 0023 and above)

TABLE 6-5. ASSEMBLY A12, AUXILIARY BOARD PARTS LIST
(Serial No. 0013 through 0016; 0023 and above)

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
A12	Auxiliary Board Assembly	C139-559	C139-559	93459
C1-C15	Not Used			
C16	Capacitor, cer, 0.1uF, 10%, 100V	34-28-104	CK06BX104K	81349
C17	Capacitor, cer, 0.1uF, 10%, 100V	34-28-104	CK06BX104K	81349
C18	Not Used			
C19	Not Used			
C20	Capacitor, tant, 10uF, 10%, 35V	31-80	T362C106M035AS	31433
C21-25	Not Used			
CR1	Not Used			
CR2	Diode	12-45	1N270	80131
CR3	Diode	12-45	1N270	80131
CR4	Diode	12-45	1N270	80131
CR5	Not Used			
CR6	Diode	12-51	1N3064	80131
CR7	Diode	12-51	1N3064	80131
CR8-CR11	Not Used			
Q1-Q3	Not Used			
Q4	Transistor, NPN	12-139	2N4401	80131
Q5-Q11	Not Used			
R1-R14	Not Used			
R15	Resistor, 33.2K, 1%, 1/8W	25-20-33R2K	RN60C3322F	81349
R16	Resistor, 31.6K, 1%, 1/8W	25-20-31R6K	RN60C3162F	81349
R17	Resistor, 31.6K, 1%, 1/8W	25-20-31R6K	RN60C3162F	81349
R18	Resistor, 76.8K, 1%, 1/8W	25-20-76R8K	RN60C7682F	81349
R19	Resistor, 33.2K, 1%, 1/8W	25-20-33R2K	RN60C3322F	81349
R20	Resistor, 10K, 5%, ¼W	25-25-10K	RC07GF103J	81349
R21-R34	Not Used			
R35	Resistor, 76.8K, 1%, 1/8W	25-20-76R8K	RN60C7682F	81349
R36	Resistor, 22K, 5%, ¼W	25-25-22K	RC07GF223J	81349
R37	Resistor, 10K, 5%, ¼W	25-25-10K	RC07GF103J	81349
U1	Not Used			
U2	Not Used			
U3	IC, Op. Amp., FET	12-283	LF356H	27014

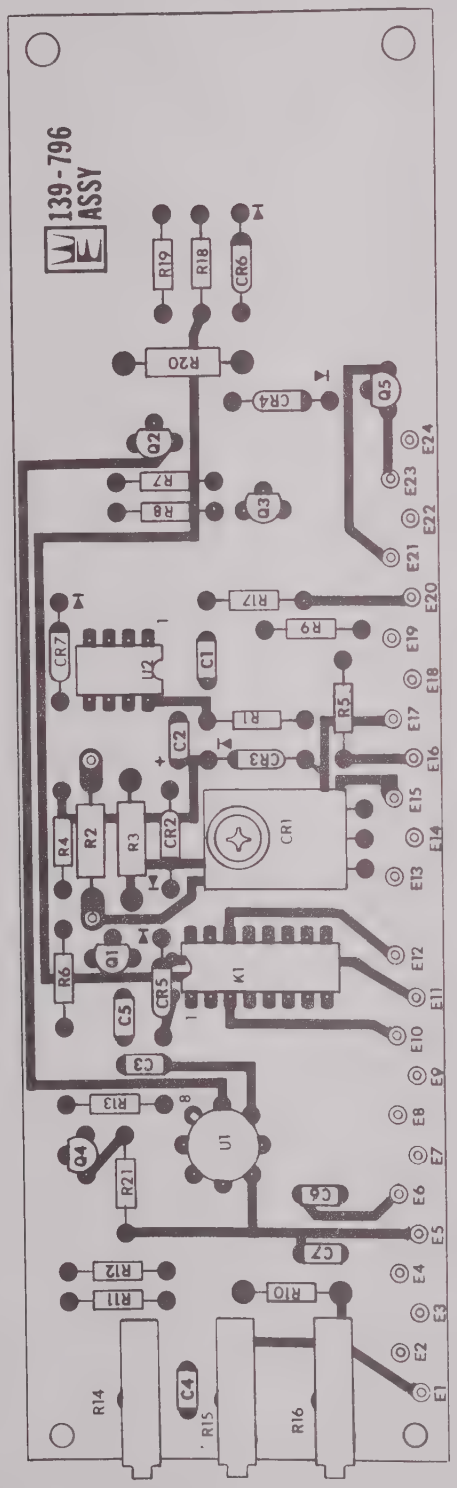


Figure 6-6. Model 437A, Assembly A13, Crowbar and Preset M1 Control, Component Location (Serial No. 0023 and above)

TABLE 6-6. ASSEMBLY A13, CROWBAR AND PRESET M1 CONTROL PARTS LIST
(Serial No. 0023 and above)

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
A13	Crowbar & Preset M1 Control Assembly	D139-796	D139-796	93459
C1	Capacitor, cer, 150pF, 10%, 200V	34-27-151	CK05BX151K	81349
C2	Capacitor, tant, 10uF, 10%, 35V	31-80	T362C106M035AS	31433
C3	Capacitor, cer, 150pF, 10%, 200V	34-27-151	CK05BX151K	81349
C4	Capacitor, cer, 0.1uF, 10%, 50V	34-27-104	CK05BX104K	81349
C5	Capacitor, cer, 0.01uF, 10%, 100V	34-27-103	CK05BX103K	81349
C6	Capacitor, cer, 0.1uF, 10%, 50V	34-27-104	CK05BX104K	81349
C7	Capacitor, cer, 0.1uF, 10%, 50V	34-27-104	CK05BX104K	81349
CR1	Diode, SCR	12-215	2N4441	80131
CR2	Diode, Rectifier	12-110	1N4383	80131
CR3[1]	Diode, Zener, (selected)	12		
CR4	Diode, Signal	12-51	1N3064	80131
CR5	Diode, Signal	12-51	1N3064	80131
CR6	Diode, Signal	12-51	1N3064	80131
CR7	Diode, Zener, 24V	12-225	1N4749A	24539
K1	Dual DPDT Relay	47-32	53451-1	00779
Q1	Transistor, PNP	12-140	2N4403	80131
Q2	Transistor, PNP	12-140	2N4403	80131
Q3	Transistor, NPN	12-139	2N4401	80131
Q4	Transistor, NPN	12-139	2N4401	80131
Q5	Transistor, NPN	12-139	2N4401	80131
R1	Resistor, carb, 33 ohm, 5%, ¼W	25-25-33	RC07GF330J	81349
R2[1]	Resistor, film, (selected), 1%, 1/8W	25-20	RN60C	81349
R3	Resistor, film, 2.8K, 1%, 1/8W	25-20-2800	RN60C2801F	81349
R4	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R5	Resistor, carb, 100 ohm, 5%, ¼W	25-25-100	RC07GF101J	81349
R6	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R7	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R8	Resistor, carb, 10K, 5%, ¼W	25-25-10K	RC07GF103J	81349
R9	Resistor, carb, 100K, 5%, ¼W	25-25-100K	RC07GF104J	81349
R10	Resistor, carb, 6.8K, 5%, ¼W	25-25-6800	RC07GF682J	81349
R11	Resistor, film, 15K, 1%, 1/8W	25-20-15K	RN60C1502F	81349
R12	Resistor, film, 10K, 1%, 1/8W	25-20-10K	RN60C1002F	81349
R13	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R14	Resistor, var, 1K	20-203-102	3009P-1-102	32997
R15	Resistor, var, 1K	20-203-102	3009P-1-102	32997
R16	Resistor, var, 1K	20-203-102	3009P-1-102	32997
R17	Resistor, carb, 100 ohm, 5%, ¼W	25-25-100	RC07GF101J	81349
R18	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R19	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R20	Resistor, carb, 30K, 5%, ¼W	25-25-30K	RC07GF303J	81349
R21	Resistor, carb, 100 ohm, 5%, ¼W	25-25-100	RC07GF101J	81349
U1	IC, Op. Amp.	12-283	LF356H	27014
U2	IC, Overvoltage Sensing	15-07-3423P1	MC3423P1	04713

[1] Value is selected at test.

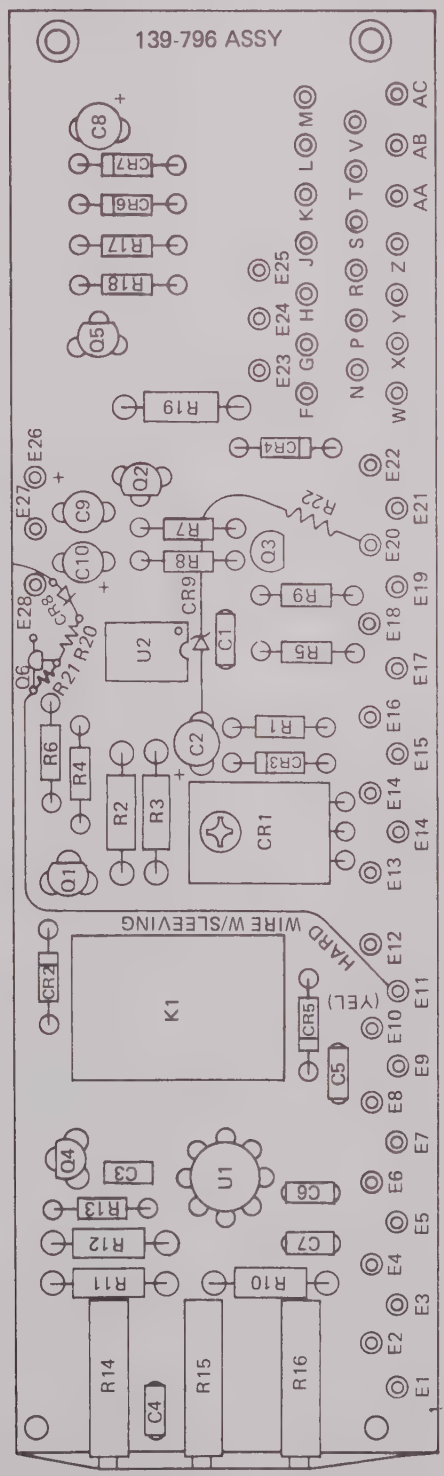


Figure 6-7. Model 437A, Assembly A13, Auxiliary Board, Component Location (Serial No. 0012 thru 0022)

TABLE 6-7. ASSEMBLY A13, AUXILIARY BOARD PARTS LIST
(Serial No. 0012 through 0022)

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
A13	Auxiliary Board	D139-796	D139-796	93459
C1	Capacitor, cer, 150pF, 10%, 200V	34-27-150	CK05BX151K	81349
C2	Capacitor, cer, 10uF, 10%, 35V	31-80	T362C106M035AS	31433
C3	Capacitor, cer, 150pF, 10%, 200V	34-27-150	CK05BX151K	81349
C4	Capacitor, cer, 0.1uF, 10%, 100V	34-27-R1	CK05BX104K	81349
C5	Capacitor, cer, 0.01uF, 10%, 100V	34-27-R01	CK05BX103K	81349
C6	Capacitor, cer, 0.1uF, 10%, 100V	34-27-R1	CK05BX104K	81349
C7	Capacitor, cer, 0.1uF, 10%, 100V	34-27-R1	CK05BX104K	81349
C8	Capacitor, cer, 10uF, 10%, 35V	31-80	T362C106M035AS	31433
C9	Capacitor, cer, 10uF, 10%, 35V	31-80	T362C106M035AS	31433
C10	Capacitor, cer, 10uF, 10%, 35V	31-80	T362C106M035AS	31433
CR1	Diode, SCR	12-215	2N4441	80131
CR2	Diode, Rectifier	12-110	1N4383	80131
CR3[1]	Diode, Zener, (selected)	12		
CR4	Diode	12-51	1N3064	80131
CR5	Diode	12-99	1N483B	80131
CR6	Diode	12-51	1N3064	80131
CR7	Diode	12-51	1N3064	80131
CR8	Diode	12-51	1N3064	80131
CR9	Diode, Zener, 24V	12-225	1N4749A	24539
K1	Relay	47-29	JRM1049	12300
Q1	Transistor, PNP	12-140	2N4403	80131
Q2	Transistor, PNP	12-140	2N4403	80131
Q3	Transistor, NPN	12-139	2N4401	80131
Q4	Transistor, PNP	12-140	2N4403	80131
Q5	Transistor, NPN	12-139	2N4401	80131
Q6	Transistor, NPN	12-139	2N4401	80131
R1	Resistor, carb, 33 ohm, 5%, ¼W	25-25-33	RC07GF330J	81349
R2[1]	Resistor, film, to be selected	25-20	RN60C	81349
R3	Resistor, film, 2.8K, 1%, 1/8W	25-20-2800	RN60C282F	81349
R4	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R5	Resistor, carb, 100 ohm, 5%, ¼W	25-25-100	RC07GF101J	81349
R6	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R7	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R8	Resistor, carb, 10K, 5%, ¼W	25-25-10K	RC07GF103J	81349
R9	Resistor, carb, 100K, 5%, ¼W	25-25-100K	RC07GF104J	81349
R10	Resistor, film, 6.04K, 1%, 125W	25-20-6R04K	RN60C6041F	81349
R11	Resistor, film, 15K, 1%, 1/8W	25-20-15K	RN60C1502F	81349
R12	Resistor, film, 10K, 1%, 1/8W	25-20-10K	RN60C1002K	81349
R13	Resistor, carb, 1K, 5%, ¼W	25-25-1000	RC07GF102J	81349
R14	Resistor, var, 1K	20-203-102	3009P-1-102	32997
R15	Resistor, var, 1K	20-203-102	3009P-1-102	32997
R16	Resistor, var, 1K	20-203-102	3009P-1-102	32997
R17	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R18	Resistor, carb, 5.6K, 5%, ¼W	25-25-5.6K	RC07GF562J	81349
R19[1]	Resistor, film, to be selected	25-20	RN60C	81349
R20	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R21	Resistor, carb, 4.7K, 5%, ¼W	25-25-4700	RC07GF472J	81349
R22	Resistor, carb, 100 ohm, 5%, ¼W	25-25-100	RC07GF101J	81349

[1] Value to be selected at test.

TABLE 6-7. ASSEMBLY A13, AUXILIARY BOARD PARTS LIST (Cont.)
(Serial No. 0012 through 0022)

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr Code
U1	IC, Op. Amp.	12-283	LF356H	27014
U2	IC, Overvoltage Sensing	15-07-3423P1	MC3423P1	04713

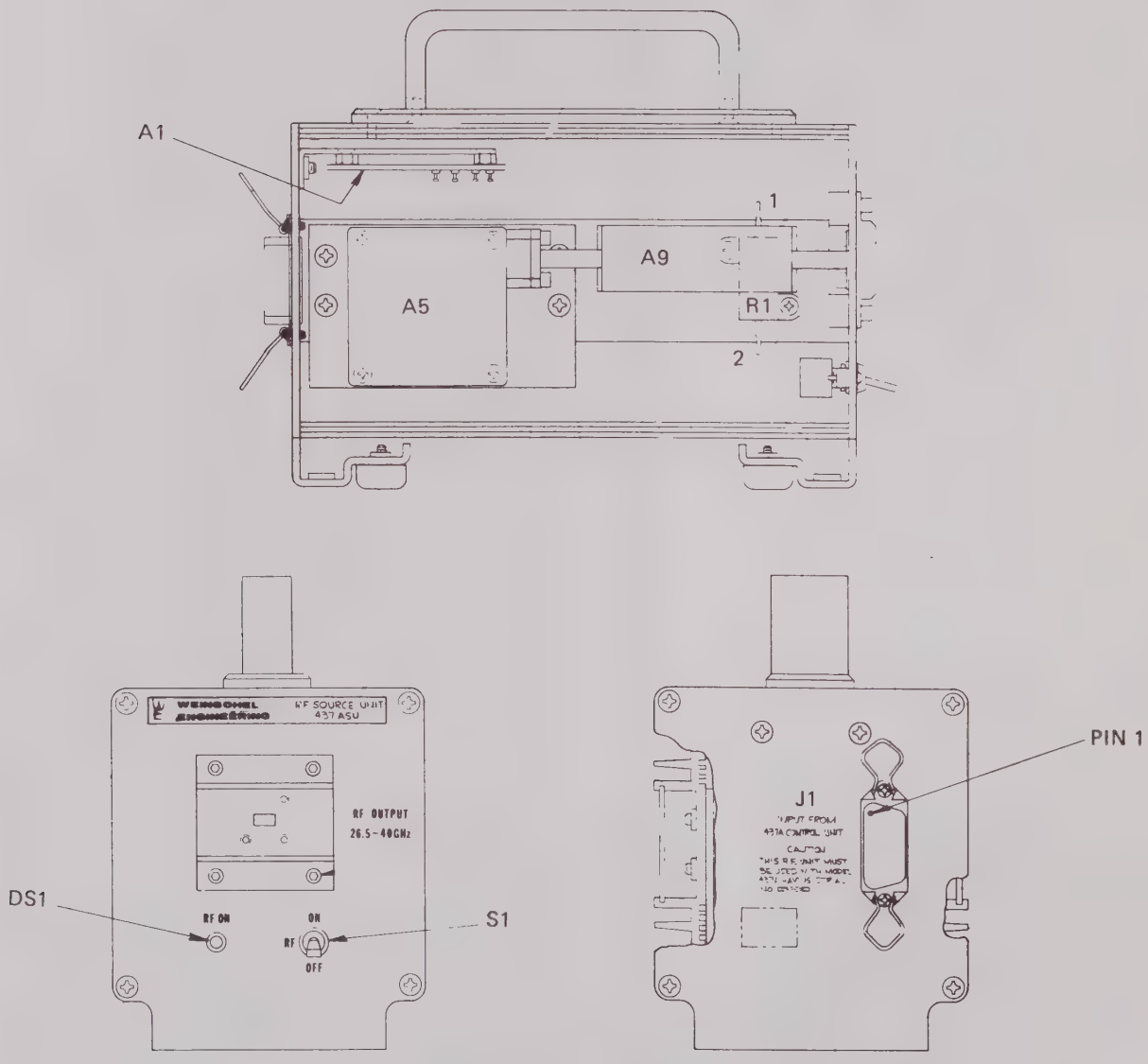


Figure 6-8. Model 437ASU, Main Assembly, Component Location

TABLE 6-8. MODEL 437ASU, MAIN ASSEMBLY PARTS LIST

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
	Model 437ASU Main Assembly	D139-798	D139-798	93459
A1	Crowbar & YIG Coil Compensation Network Assembly	C139-758	C139-758	93459
A5	YIG-Tuned GaAs Oxcillator	C16-110	5610-11	14482
A5[1]	YIG-Tuned GaAs Oscillator	C16-110	5610-6	14482
A9	Waveguide Oscillator	1-120	2571-1810	12855
DS1	LED	12-191	5082-4403	50434
J1	Connector, 14 Pin	62-138	57-40140	13511
R1[1]	Resistor, 6 ohm, 5%, 25W	26-8-6	HT-25-6	12463
S1	Switch, DPST	55-51	7101-P3-PY-Z-BE	09353

[1] Used only in units with serial numbers 0022 and below.

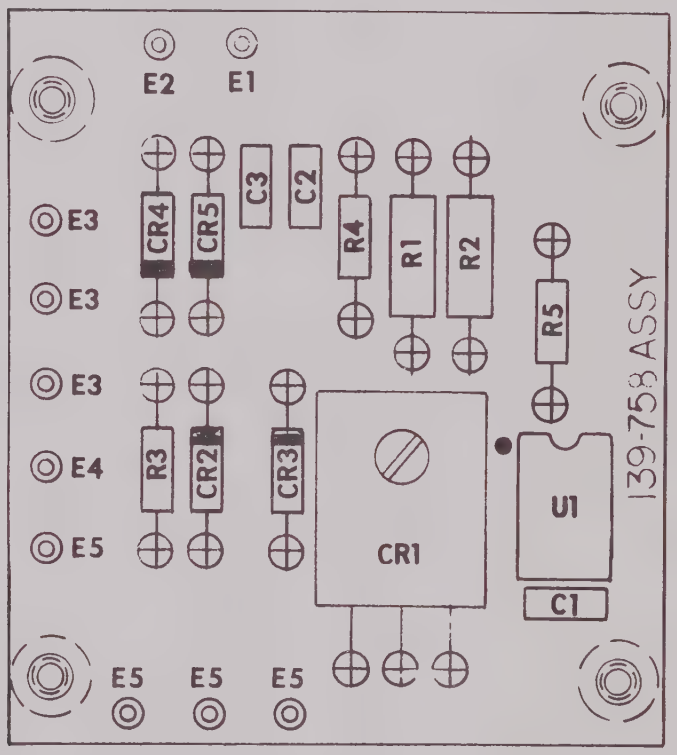


Figure 6-9. Model 437ASU, Assembly A1, Crowbar and Yig Coil Compensation Network, Component Location

TABLE 6-9.
ASSEMBLY A1, CROWBAR AND YIG COIL COMPENSATION NETWORK PARTS LIST

Ref. Des.	Description	Part Number	Mfr. Part Number	Mfr. Code
A1	Crowbar & YIG Coil Compensation Network Assembly	C139-758	C139-758	93459
C1	Capacitor, cer, 0.22uF, 20%, 50V	34-23-R22	7CZ5U223X0050D1	56289
C2	Capacitor, cer, 0.01uF, 10%, 200V	34-28-103	CK06BX103K	81349
C3	Capacitor, cer, 150pF, 10%, 200V	34-27-151	CK05BX151K	81349
CR1	Diode, SCR	12-215	2N4441	80131
CR2	Diode	12-110	1N4383	80131
CR3[1]	Diode, Zener, (selected)	12-		
CR4	Diode	12-110	1N4383	80131
CR5	Diode, Zener, 15V	12-196	1N4744A	80131
R1[1]	Resistor, film, (selected), 1%, 1/8W	25-20	RN60C	81349
R2	Resistor, film, 2.8K, 1%, 1/8W	25-20-2800	RN60C2801F	81349
R3	Resistor, carb, 100 ohm, 5%, ¼W	25-25-100	RC07GF101J	81349
R4	Resistor, carb, 3.9K, 5%, ¼W	25-25-3900	RC07GF392J	81349
R5	Resistor, carb, 33 ohm, 5%, ¼W	25-25-33	RC07GF330J	81349
U1	IC, Overvoltage Sensing	15-07-3423P1	MC3423P1	04713

[1] Value to be selected at test.

SECTION 7
DIAGRAMS

7.1 INTRODUCTION

This section contains schematic diagrams for the Model 437A/437ASU RF Unit assemblies and subassemblies. Refer to the component location drawings and corresponding parts list in Section 6. Table 7-1 provides schematic notes which are unique but common to all diagrams in this section.

7.2 LIST OF FIGURES

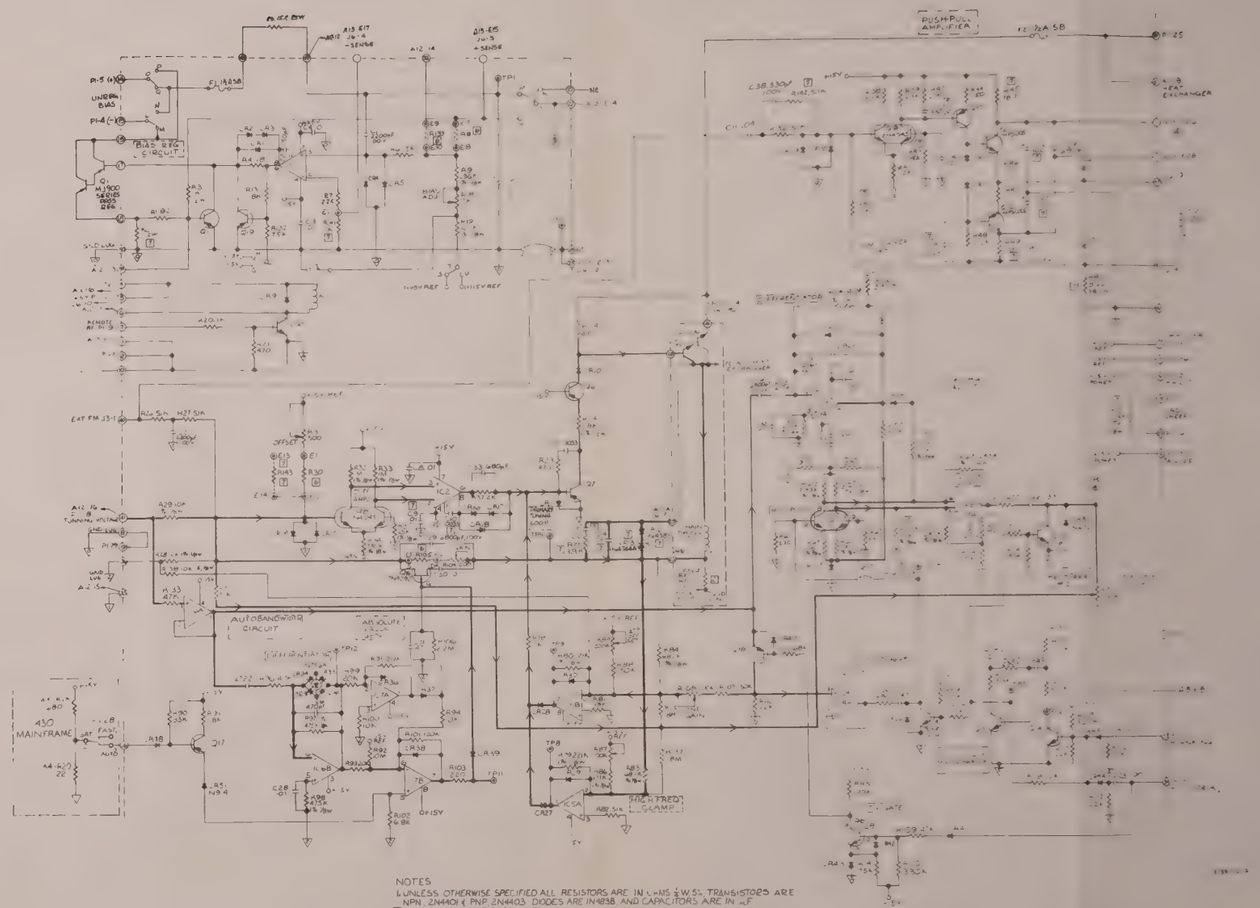
The following is a list of figures included in this section.

Figure No.	Description	Page No.
7-1	Tuning and Bias Supply, Assembly A2, Schematic Diagram	7-3/7-4
7-2	Symmetrical Sweep Width Switch, Assembly A4, Schematic Diagram	7-5/7-6
7-3	Heat Exchanger, Assembly A11, Schematic Diagram	7-7/7-8
7-4	Auxiliary Board, Assembly A12, Schematic Diagram	7-9/7-10
7-5	Crowbar and Preset M1 Control, Assembly A13, Schematic Diagram (Serial No. 0023 and up)	7-11/7-12
7-6	Auxiliary Board, Assembly A13, Schematic Diagram (Serial No. 0012-0022)	7-13/7-14
7-7	Model 437A, Overall Schematic (Serial No. 0023 and up)	7-15/7-16
7-8	Model 437A, Overall Schematic (Serial No. 0012-0022)	7-17/7-18
7-9	Model 437ASU Overall Schematic	7-19/7-20

TABLE 7-1. SCHEMATIC NOTES

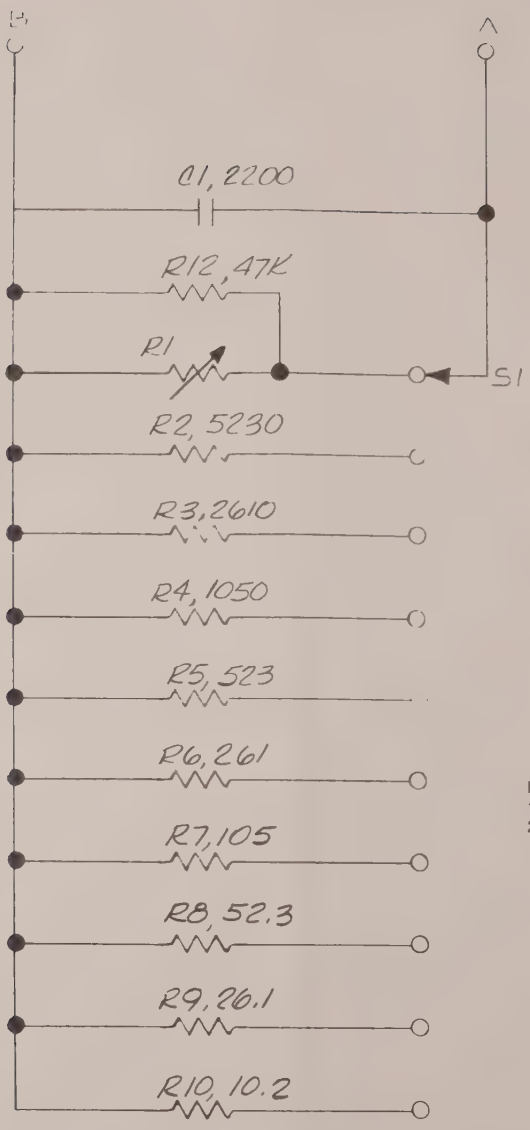
1. Resistance in ohms, capacitance in microfarads unless otherwise indicated.
2. Front panel designation
3. Rear panel designation
4. ----- Printed circuit card border
5. ——— Main signal path
6. ═══ Semi-Rigid Coaxial
7. P/O = part of
8. CW Wiper moves toward CW when control rotated clockwise
9. Test point
10. Zener diode
    or
11. Constant Current Diode
12. (A) Hardwire connection to board, and number
13. Denotes Power Return
    Denotes Reference Return
    Denotes Tuning Voltage Return
    Denotes FM CKT Return
    Denotes 5-Volt Return
14. LED

COMPONENT	SERIAL NO. VALUE/USAGE	
	0012-0022	0023-UP
C9	Not used	.01 μF
C10	Not used	3300 pF
C12	2200 pF	330 pF
C14	.01 μF	Not used
C15	.22 μF	Not used
C34	330 pF	Not used
C36	Not used	100 μF
C37	Not used	100 μF
CR12	IN4383	Not used
CR13	IN4744A	Not used
R2	1Ω, 2W	0.68Ω, 2W
R25	3.9K	Not used
R40	12K	100K
R43	10K	180K
R45	47Ω, 1W	78.7Ω, 1%, 3W
R49	47Ω, 1W	78.7Ω, 1%, 3W
R61	220K	51K
R85	1.2Ω, 1/2W	8.66Ω, 1%, 1W
R129	Select at test	75K, 1%, 1/8W
R130	Select at test	75K, 1%, 1/8W
R141	Not used	1K
R142	51K	5.1K
R143	Select at test	Not used



NOTES
UNLESS OTHERWISE SPECIFIED ALL RESISTORS ARE IN OHMS ±W 5%. TRANSISTORS ARE NPN, 2N4401 (PNP 2N4403. DIODES ARE IN4938, AND CAPACITORS ARE IN μF
1. 6.8Ω IN SOME EARLIER UNITS.
2. PARTIAL EXAMPLE PINOUT DESTINATIONS ARE INCLUDED ON THIS DWG REFER TO OVERALL SCHEMATIC DIA. FOR COMPLETE PINOUT DESTINATIONS
3. CONNECTIONS TO A13-E26 (A13-E28 ONLY ON SERIAL NO. BELOW 0023.
4. JUMPER PLACEMENTS ARE AS FOLLOWS: H-J, L-M, S-T, B-C, K-Y, N-O, W-Y, X-Z.
5. SELECT AT TEST: COMPONENTS MAY BE USED IN COMBINATION (SERIES, PARALLEL, OR BOTH) OR NOT USED AS NECESSARY TO ACHIEVE UNIT SPECIFICATIONS.
6. DENOTES VALUE AND USAGE DIFFER AMONG UNIT SERIAL NUMBERS; REFER TO VALUE/USAGE CHART.

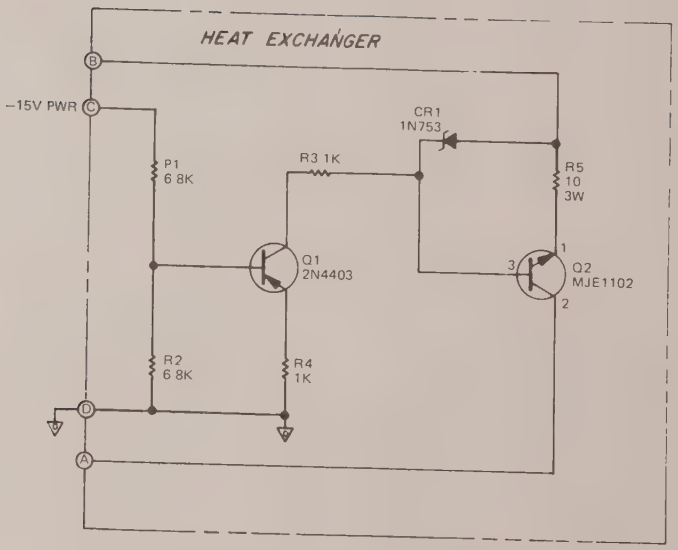
Figure 7-1. Model 437A, Assembly A2, YIG Bias and Tuning Supply Schematic Diagram



NOTES:
1. C1 VALUE IN pF
2. RESISTOR VALUES IN OHMS

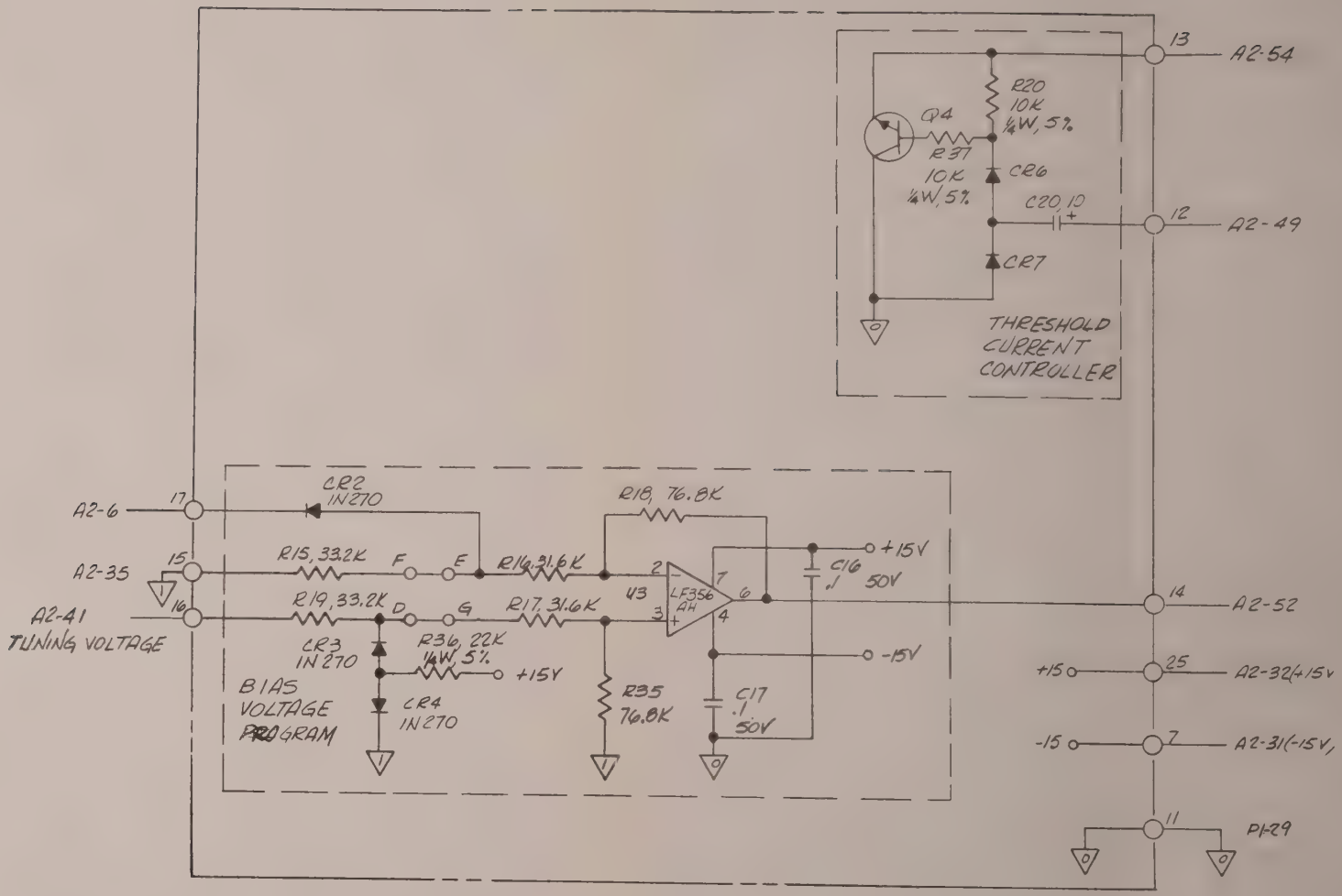
B139—794—A

Figure 7-2. Model 437A, Assembly A4, Symmetrical Sweep Width Switch, Schematic Diagram



NOTE:
UNLESS OTHERWISE SPECIFIED ALL
RESISTORS ARE IN OHMS, 1/4W, 5%

Figure 7-3. Model 437A, Assembly A11, Heat Exchanger Schematic Diagram



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   RESISTORS ARE IN OHMS 1/8 W, 1%
   TRANSISTORS ARE NPN 2N4401
   PNP 2N4403
   CAPACITORS ARE IN μF
   DIODES ARE IN914 OR IN3064 (INTERCHANGEABLE)

C139-1124-A

Figure 7-4. Model 437A, Assembly A12, Auxiliary Board, Schematic Diagram

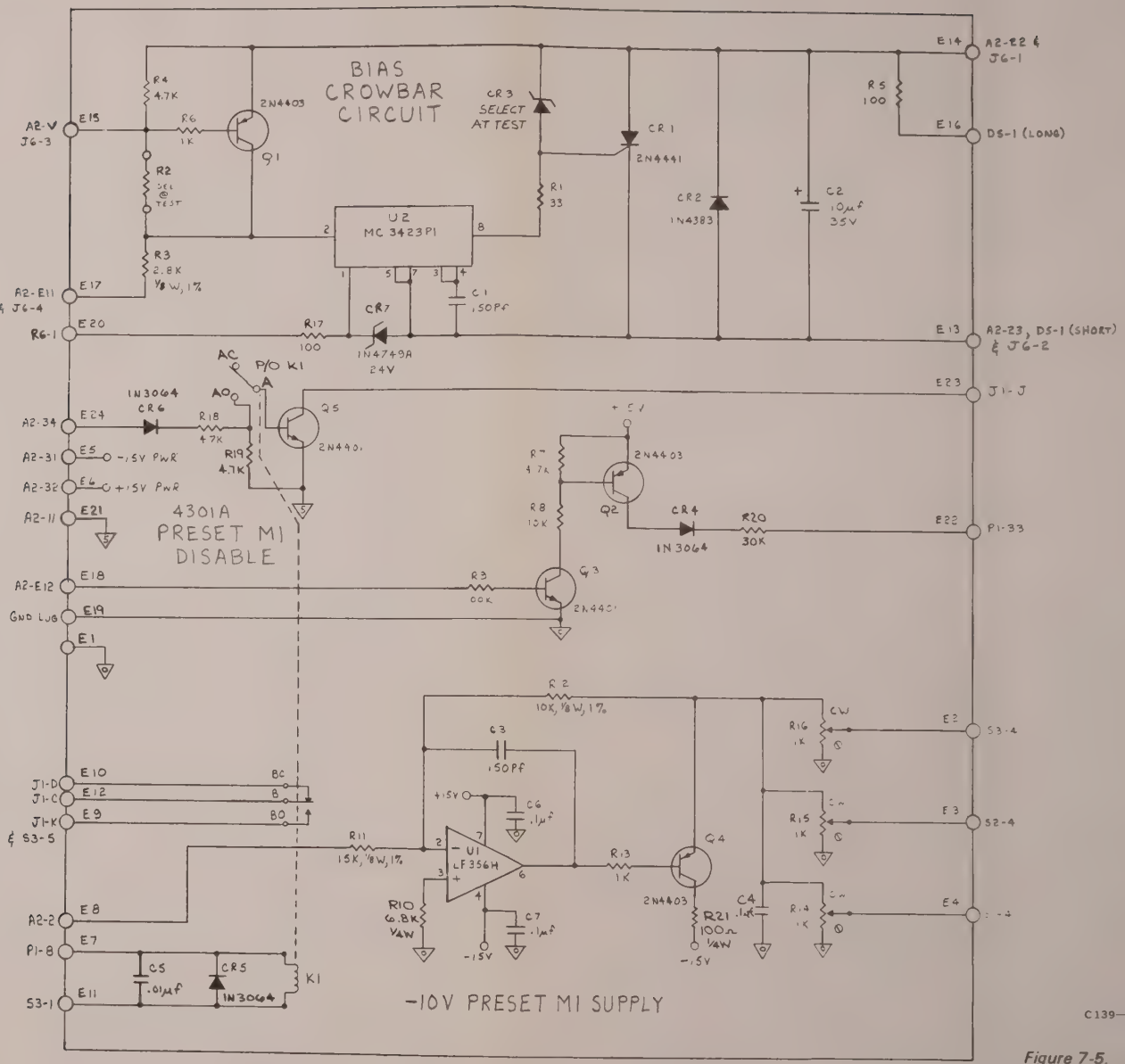


Figure 7-5. Model 437A, Assembly A13, Crowbar and Preset M1 Control Schematic Diagram (Serial No. 0023 and Up)

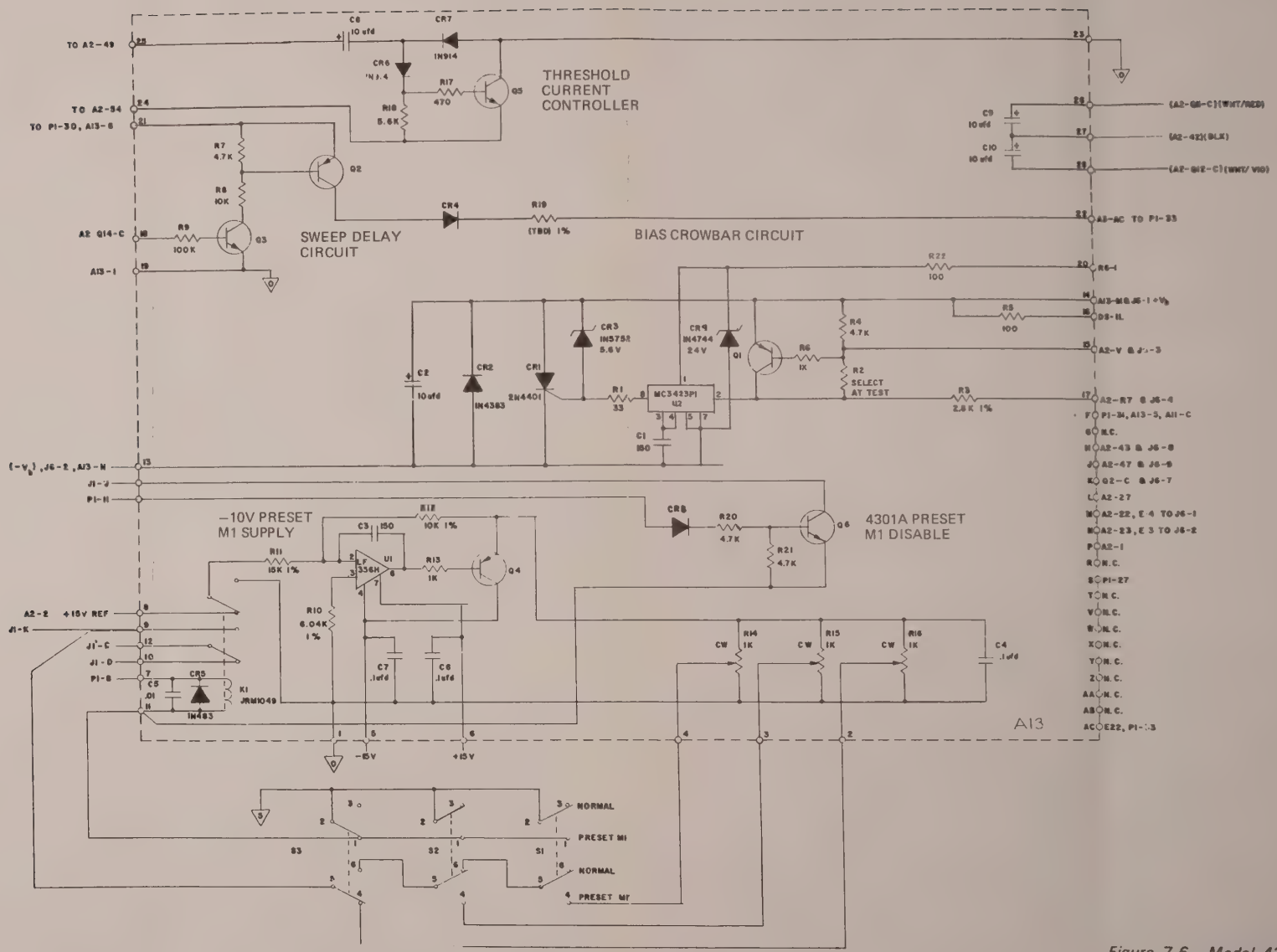


Figure 7-6. Model 437A, Assembly A13, Auxiliary Board, Schematic Diagram (Serial No. 0012-0022)

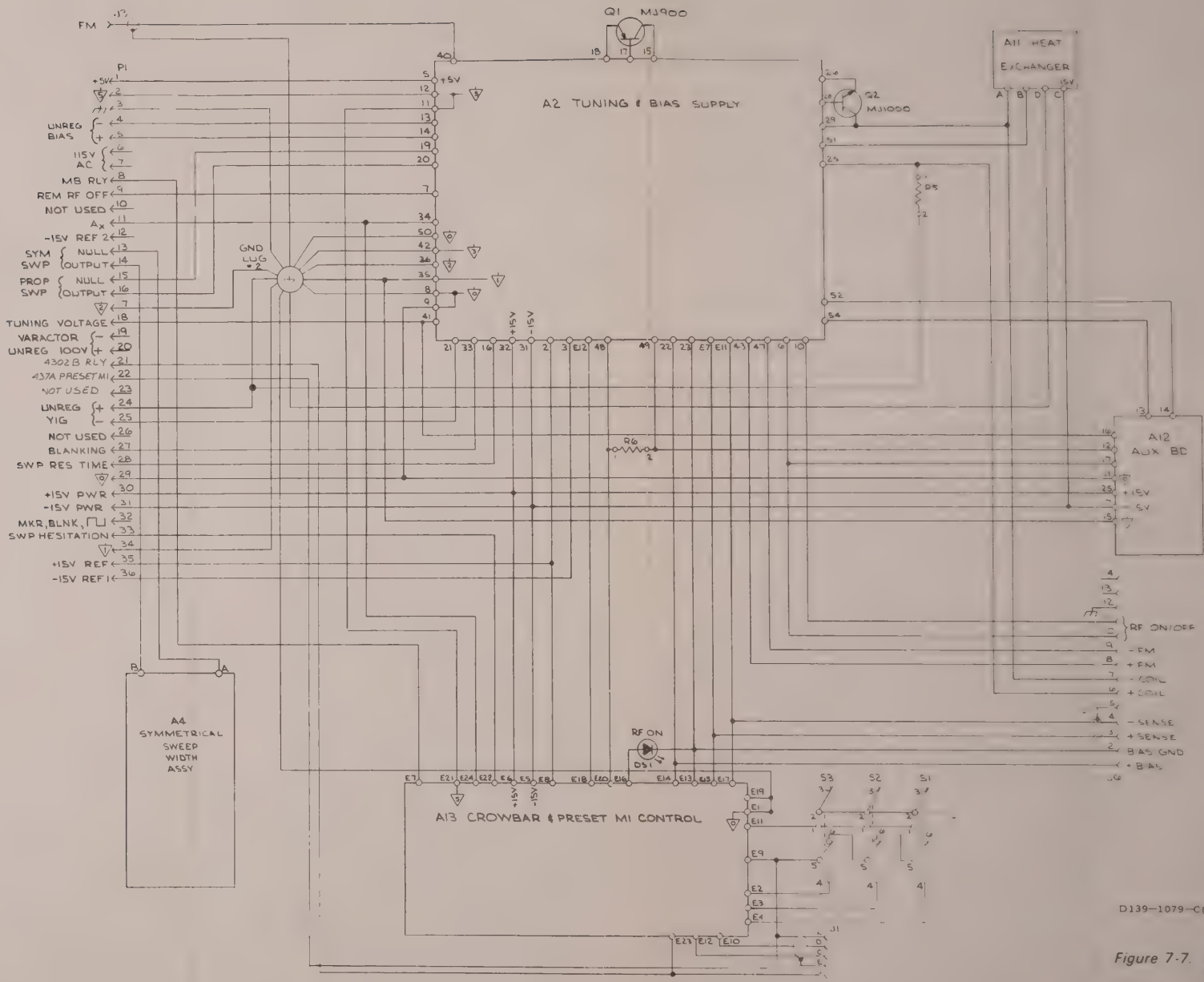
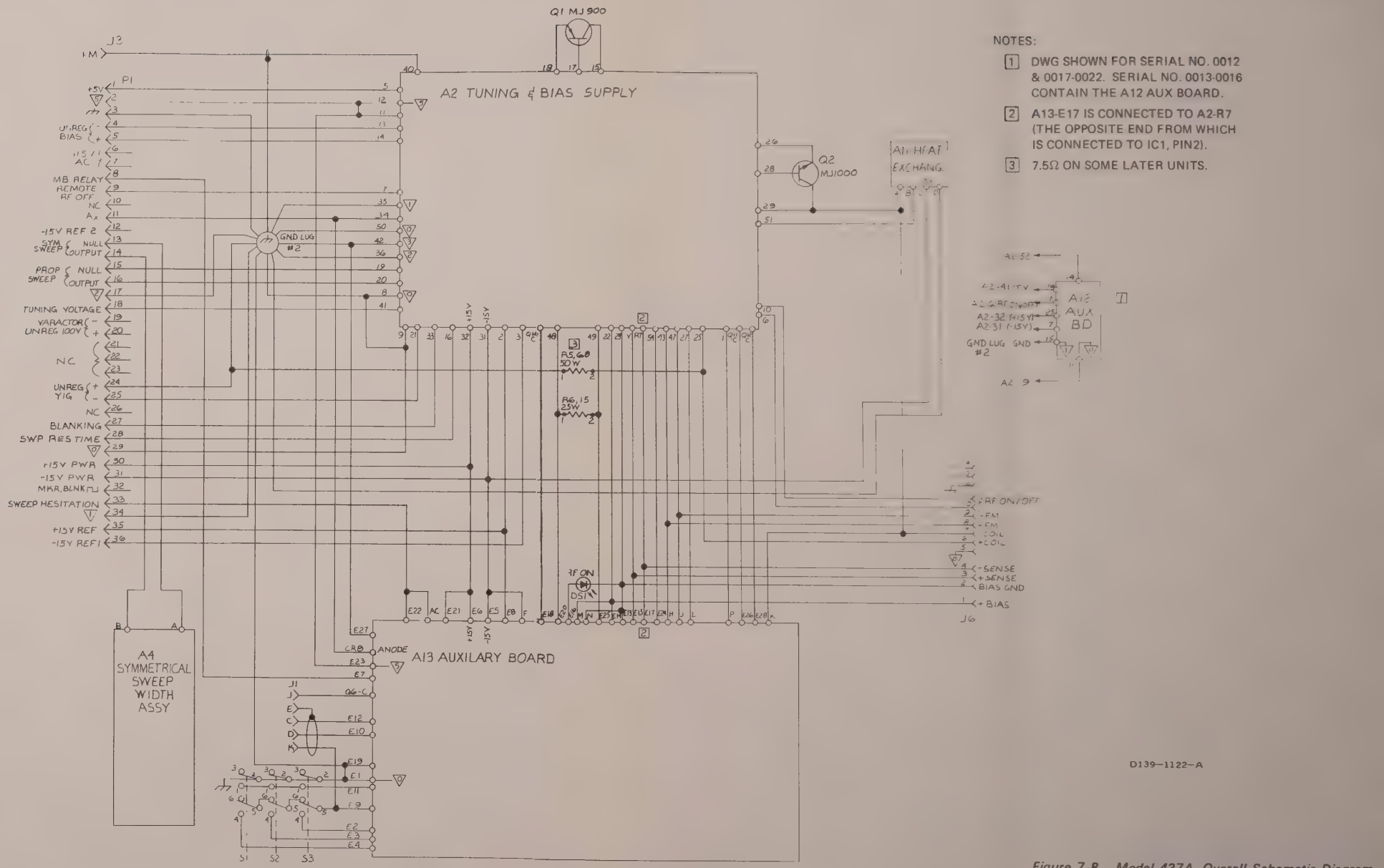


Figure 7-7. Model 437A, Overall Schematic Diagram (Serial No. 0023 and Up)

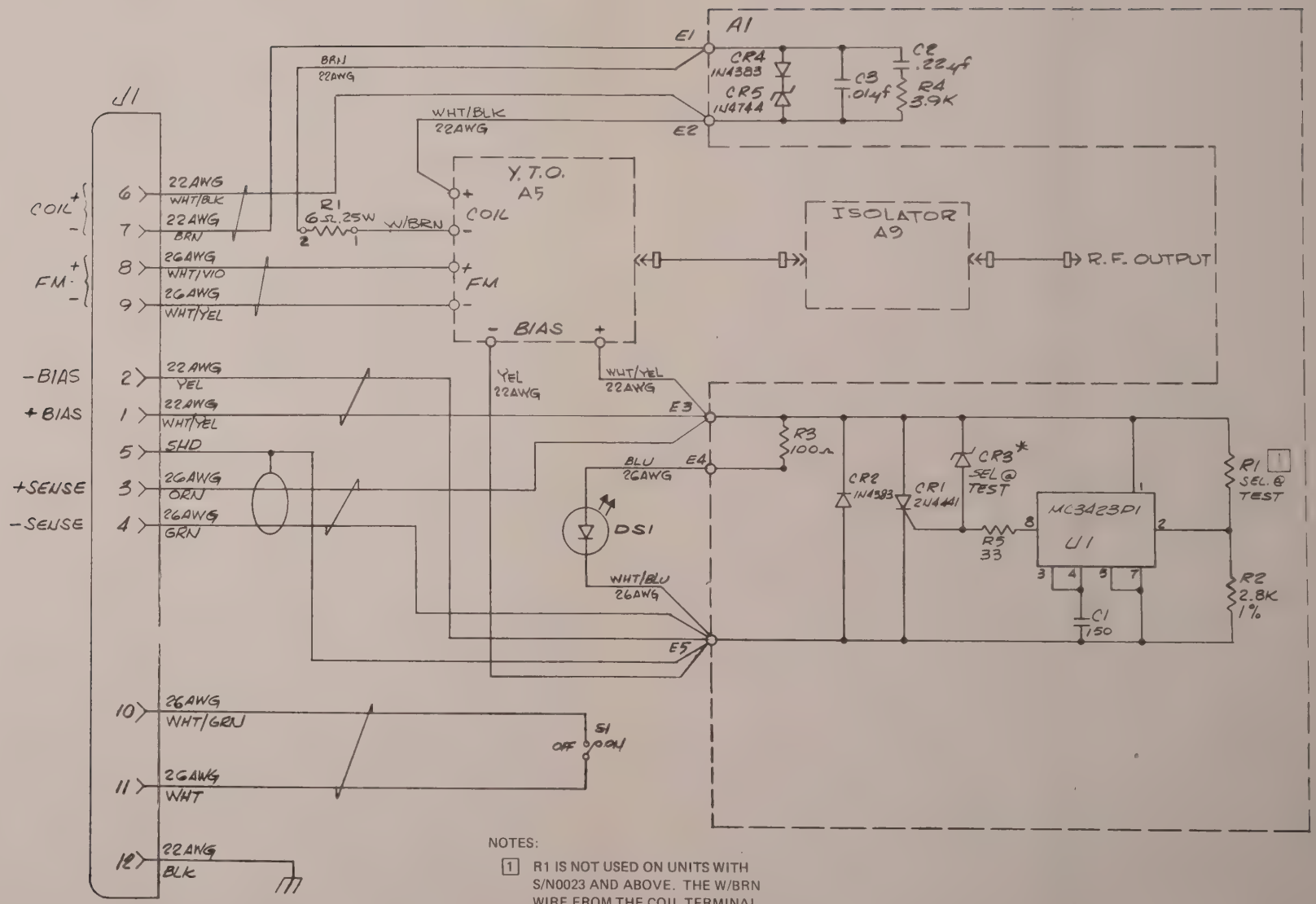


NOTES:

1. DWG SHOWN FOR SERIAL NO. 0012 & 0017-0022. SERIAL NO. 0013-0016 CONTAIN THE A12 AUX BOARD.
2. A13-E17 IS CONNECTED TO A2-R7 (THE OPPOSITE END FROM WHICH IS CONNECTED TO IC1, PIN2).
3. 7.5Ω ON SOME LATER UNITS.

D139—1122—A

Figure 7-8. Model 437A, Overall Schematic Diagram (Serial No. 0012-0022)



NOTES:

[1] R1 IS NOT USED ON UNITS WITH S/N0023 AND ABOVE. THE W/BRN WIRE FROM THE COIL TERMINAL IS CONNECTED TO A1-E1.

C139—760—C

Figure 7-9. Model 437ASU Overall Schematic Diagram

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer/Address
00000	U.S.A. Common: Any supplier of U.S.
00136	McCoy Electronics: Mount Holly Springs, Pa.
00213	Sage Electronics Corp.: Rochester, N.Y.
00287	Cemco Inc.: Danielson, Conn.
00334	Humidial: Colton, Calif.
00348	Microtron Co., Inc.: Valley Stream, N.Y.
00373	Garlock Inc.: Cherry Hill, N.J.
00656	Aerovox Corp.: New Bedford, Mass.
00779	Amp. Inc.: Harrisburg, Pa.
00781	Aircraft Radio Corp.: Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.: Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.: Pickens, S.C.
00866	Goe Engineering Co.: City of Industry, Calif.
00891	Carl F. Holmes Corp.: Los Angeles, Calif.
00929	Microlab Inc.: Livingston, N.J.
01002	General Electric Co., Capacitor Dept.: Hudson Falls, N.Y.
01009	Alden Products Co.: Brockton, Mass.
01121	Allen Bradley Co.: Milwaukee, Wis.
01255	Litton Industries, Inc.: Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.: Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.: Dallas, Texas
01349	The Alliance Mfg. Co.: Alliance, Ohio
01589	Pacific Relays, Inc.: Van Nuys, Calif.
01670	Gudebrod Bros, Silk Co.: New York, N.Y.
01884	Sprague: Longwood, Fla
01930	Amerock Corp.: Rockford, Ill.
01961	Pulse Engineering Co. : Santa Clara, Calif.
02114	Ferroxcube Corp. of America: Saugerties, N.Y.
02116	Wheelock Signals, Inc.: Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.: Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.: Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.: Somerville, N.J.
02771	Vocaline Co. of America, Inc.: Old Saybrook, Conn.
02777	Hopkins Engineering Co.: San Fernando, Calif.
02875	Hudson Tool & Die Co.: Newark, N.J.
03508	G. E. Semiconductor Prod. Dept.: Syracuse, N.Y.
03705	Apex Machine & Tool Co.: Dayton, Ohio
03797	Eldema Corp.: Compton, Calif.
03818	Parker Seal Co.: Los Angeles, Calif.
03877	Transitron Electric Corp.: Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.: Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant: Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.: Hartford, Conn.
04013	Taurus Corp.: Lambertville, N.J.
04062	Arco Electronic Inc.: Great Neck, N.Y.
04222	Hi-Q Division of Aerovox: Myrtle Beach, S.C.
04354	Precision Paper Tube Co.: Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.: Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.: Mountain View, Calif.
04673	Dakota Engr. Inc.: Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.: Phoenix, Az.
04732	Filtron Co., Inc. Western Div.: Culver City, Calif.
04773	Automatic Electric Co.: Northlake, Ill.
04796	Sequoia Wire Co.: Redwood City, Calif.
04811	Precision Coil Spring Co. : El Monte, Calif.
04870	P. M. Motor Company: Westchester, Ill.
04919	Component Mfg. Service Co.: W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.: Los Angeles, Calif.
05245	Components Corp.: Chicago, Ill.
05276	Pomona Electronics Co., Inc.: Pomona, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept. Youngwood, Pa.
05347	Ultronix, Inc.: San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.: New York, N.Y.
05574	Viking Ind. Inc.: Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.: Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.): Cleveland, Ohio
05624	Barber Colman Co.: Rockford, Ill.
05728	Tiffen Optical Co.,: Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.: Westbury, N.Y.
05783	Stewart Engineering Co.: Santa Cruz, Calif.
05820	Wakefield Engineering Inc.: Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.: Bridgeport, Conn.
06090	Raychem Corp.: Redwood City, Calif.
06175	Bausch and Lomb Optical.: Rochester, N.Y.
06402	E.T.A. Products Co. of America: Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.: New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.: Penacook, N.H.
06666	General Devices Co., Inc.: Indianapolis, Ind.
06751	Components Inc., Ariz. Div.: Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.: Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.: San Carlos, Calif.
07088	Kelvin Electric Co.: Van Nuys, Calif.
07126	Digitran Co.: Pasadena, Calif.
07137	Transistor Electronics Corp.: Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.: Elmira, N.Y.
07149	Filmohm Corp.: New York, N.Y.
07233	Cinch-Graphik Co.: City of Industry, Calif.
07256	Silicon Transistor Corp.: Carle Place, N.Y.
07261	Avnet Corp.: Culver City, Calif.
07263	Fairchild Camera & Inst. Corp, Semiconductor Div.: Mountain View, Calif.
07322	Minnesota Rubber Co.: Minneapolis, Minn.
07387	Birtcher Corp., The: Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc.,: Mt. View Operations: Mountain View, Calif.
07688	Joint Electron Device Engineering Council
07700	Technical Wire Products Inc.: Cranford, N. J.
07829	Bodine Elect. Co.: Chicago, Ill.
07910	Continental Device Corp.: Hawthorne, Calif.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
07933	Raytheon Mfg. Co., Semiconductor Div.: Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.: Rockaway, N.J.
08145	U.S. Engineering Co.: Los Angeles, California
08289	Blinn, Delbert Co.: Pomona, Calif.
08358	Burgess Battery Co.: Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.: Los Angeles, Calif.
08664	Bristol., The: Waterbury, Conn.
08717	Sloan Company: Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.: Phoenix, Arizona
08727	National Radio Lab. Inc.: Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of C. B. S. Inc.: Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.: Cleveland, Ohio
08984	Mel-Rain: Indianapolis, Ind.
09021	Airco Speer: Bedford, Pa.
09026	Babcock Relays Div.: Costa Mesa, Calif.
09134	Texas Capacitor Co.: Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.: Burbank, Calif.
09250	Electro Assemblies, Inc.: Chicago, Ill.
09353	C & K Components Inc.: Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.: Toronto, Ontario, Canada
09922	Burndy Corp.: Norwalk, Conn.
09969	Dale: Yankgon, S.D.
10214	General Transistor Western Corp.: Los Angeles, Calif.
10411	Ti-Tal, Inc.: Berkeley, Calif.
10646	Carborundum Co.: Niagara Falls, N.Y.
11236	CTS of Berne, Inc.: Berne, Ind.
11237	Chicago Telephone of California, Inc.: So. Pasadena, Calif.
11242	Bay State Electronics Corp.: Waltham, Mass.
11312	Teledyne Inc., Microwave Div.: Palo Alto, Calif.
11314	National Seal: Downey, Calif.
11453	Precision Connector Corp.: Jamaica, N.Y.
11534	Duncan Electronics Inc.: Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group: Newark, N.J.
11717	Imperial Electronic, Inc.: Buena Park, Calif.
11870	Melabs, Inc.: Palo Alto, Calif.
12040	National Semiconductor: Danbury, Conn.
12136	Philadelphia Handle Co.: Camden, N.J.
12300	Potter and Brumfield: Ontario, Canada
12361	Grove Mfg. Co., Inc.: Shady Grove, Pa.
12463	Omtronics Mfg. Inc.: Omaha, NB
12574	Gulton Ind. Inc. Data System Div.: Alburquerque, N.M.
12697	Clarostat Mfg. Co.: Dover, N.H.
12728	Elmar Filter Corp.: W. Haven, Conn.
12855	Trak-Microwave Corp.: Tampa, Fla.
12859	Nippon Electric Co., Ltd.: Tokyo, Japan
12881	Metex Electronics Corp.: Clark, N.J.
12930	Delta Semiconductor Inc.: Newport Beach, Calif.
12954	Dickson Electronics Corp.: Scottsdale, Arizona
13103	Thermolloy: Dallas, Texas
13396	Telefunken (GmbH): Hanover, Germany
13511	Amphenol: Gatos, Calif.
13835	Midland-Wright Div. of Pacific Industries, Inc.: Kansas City, Kansas
14099	Sem-Tech: Newbury Park, Calif.
14193	Calif. Resistor Corp.: Santa Monica, Calif.
14298	American Components, Inc.: Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.: West Palm Beach, Fla.
14482	Watkins-Johnson Co., Inc.: Palo Alto, Calif.
14493	Hewlett-Packard Company: Loveland, Colo.
14655	Cornell Dublier Electric Corp.: Newark, N.J.
14674	Corning Glass Works: Corning, N.Y.
14752	Electro Cube Inc.: San Gabriel, Calif.
14960	Williams Mfg. Co: San Jose, Calif.
15203	Webster Electronics Co.: New York, N.Y.
15287	Scionics Corp.: Northridge, Calif.
15291	Adjustable Bushing Co.: N. Hollywood, Calif.
15556	Micron Electronics: Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.: Lynbrook, N.Y.
15631	Cabletronics: Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.,: Santa Clara, Calif
15801	Fenwal Elect. Inc.: Framingham, Mass.
15818	Amelco Inc.: Mt. View, Calif.
16037	Spruce Pine Mica Co.: Spruce Pine, N.C.
16179	Omni-Spectra Inc.: Farmington, Mich.
16352	Computer Diode Corp.: Lodi, N.J.
16428	Belden Corp.: Richmond, Ind.
16585	Boots Aircraft Nut Corp.: Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.: Brooklyn, N.Y.
16758	Delco Radio Div. of G. M. Corp.: Kokoma, Ind
17109	Thermonetics Inc.: Canoga Park, Calif.
17474	Tranex Company: Mountain View, Calif.
17554	Components Inc.: Biddeford, Ma.
17675	Hamlin Metal Products Corp.: Akron, Ohio
17745	Angstrohm Prec. Inc.: No Hollywood, Calif.
17850	Zeltex, Inc.: Concord, Calif.
17870	McGraw-Edison Co.: Manchester, N.H.
18042	Power Design Pacific Inc.: Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.: Palo Alto Calif.
18324	Signetics Corp.: Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.: Holliston, Mass.
18486	TRW Elect. Comp. Div.: Des Plaines, Ill.
18583	Curtis Instrument, Inc.: Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.: Malvern, Pa.
18873	E. I. DuPont and Co., Inc.: Wilmington, Del.
18911	Durant Mfg. Co.: Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.: Teterboro N. J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.: West Orange, N.J.
19589	Concoa: Baldwin Park, Calif.
19644	LRC Electronics: Horseheads, N.Y.
19701	Electra Mfg. Co.: Independence, Kansas
20183	General Atronics Corp.: Philadelphia, Pa.
21226	Executone, Inc.: Long Island City, N.Y.
21335	Fafnir Bearing Co., The: New Britain, Conn.
21520	Fansteel Metallurgical Corp.: N. Chicago, Ill.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
23042	Texscan Corp.: Indianapolis, Ind.
23783	British Radio Electronics Ltd.: Washington, D.C
24455	G. E. Lamp Division: Nela Park, Cleveland, Ohio
24539	Avantek, Inc.: Santa Clara, Calif.
24655	General Radio Co.: West Concord, Mass.
24681	Memcor Inc., Comp. Div.: Huntington, Ind.
24796	Parelco Inc.: San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.: New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.: Carlstadt, N.J
26851	Compac/Hollister Co.: Hollister, Calif.
26992	Hamilton Watch Co.: Lancaster, Pa.
27014	National Semi-Conductor: Santa Clara, Calif.
27251	Specialities Mfg. Co., Inc.: Stratford, Conn.
28480	Hewlett-Packard Co.: Palo Alto, Calif.
28520	Heyman Mfg. Co.: Kenilworth, N. J.
30817	Instrument Sepcialities Co., Inc.: Little Falls, N.J.
31433	Union Carbide: Greenville, S.C.
32997	Bourns, Inc., Trimpot Dia.: Riverside, Calif.
33173	G. E. Receiving Tube Dept.: Ownesboro, Ky.
35434	Lectrohm Inc.: Chicago, Ill
36196	Stanwyck Coil Products Ltd.: Hawkesbury, Ontario, Canada
36287	Cunningham, W. H. & Hill, Ltd.: Toronto Ontario, Canada
37942	P. R. Mallory & Co. Inc.: Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.: Akron, Ohio
40920	Miniature Precision Bearings, Inc.: Keene, N. H.
42190	Muter Co.: Chicago, Ill.
43990	C. A. Norgren Co.: Englewood, Colo.
44655	Ohmite Mfg. Co.: Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.: Doylestown, Pa.
47904	Polaroid Corp.: Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.: Southampton, Pa.
49956	Microwave & Power Tube Div.: Waltham, Mass.
50139	Allen Bradley: Salt Lake City, Utah
50434	Hewlett-Packard Co.: Palo Alto, Calif.
50721	Datel Systems: Canton, Ma.
52090	Rowan Controller Co.: Westminster, Md.
53983	Sanborn Company: Waltham, Mass.
54294	Shallcross Mfg. Co.: Selma, N.C.
55026	Simpson Electric Co.: Chicago, Ill.
55933	Sonotone Corp.: Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.: So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc. Tonawanda, N.Y.
56289	Sprague Electric Co.: North Adams, Mass.
59446	Telex Corp.: Tulsa, Okla.
59730	Thomas & Betts Co.: Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.: Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.: Pittsburgh, Pa.
62119	Universal Electric Co.: Owosso, Mich.
63743	Ward-Leonard Electric Co.: Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.: New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark: Newark, N.J.
66295	Wittek Mfg. Co.: Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.: St. Paul, Minn.
70109	Adams and Westlake: Elkhart, Ind.
70276	Allen Mfg. Co.: Hartford, Conn.
70309	Allied Control: New York, N.Y.
70318	Allmetal Screw Product Co., Inc.: Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp. Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.: Chicago, Ill.
70563	Amperite Co., Inc.: Union City, N.J.
70674	ADC Products Inc.: Minneapolis, Minn.
70903	Belden Mfg. Co.: Chicago, Ill.
70998	Bird Electronic Corp.: Cleveland, Ohio
71002	Birnbach Radio Co.: New York, N.Y.
71034	Bliley Electric Co., Inc.: Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas: Quincy, Mass.
71218	Bud Radio, Inc.: Willoughby, Ohio.
71279	Cambridge Thermionics Corp.: Cambridge, Mass.
71286	Camloc Fastener Corp.: Paramus, N.J.
71313	Cardwell Condenser Corp.: Lindenhurst, L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.: St. Louis, Mo.
71436	Chicago Condenser Corp.: Chicago, Ill.
71447	Calif. Spring Co., Inc.: Pico-Rivera, Calif.
71450	CTS Corp.: Elkhart, Ind.
71468	ITT Cannon Electric Inc.: Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.: Burbank, Calif:
71482	C. P. Clare & Co.: Chicago, Ill.
71590	Centralab Div. of Globe Union Inc. Milwaukee, Wis.
71616	Commercial Plastics Co.: Chicago, Ill.
71700	Cornish Wire Co., The: New York, N.Y.
71707	Coto Coil Co., Inc.: Providence, R.I.
71744	Chicago Miniature Lamp Works: Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.: Chicago, Ill.
71984	Dow Corning Corp.: Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.: Willimantic, Conn.
72619	Dialight Corp.: Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.: Keasby, N.J.
72699	General Instrument Corp., Cap. Div. Newark, N.J.
72765	Drake Mfg. Co.: Harwood Heights, Ill.
72825	Hugh H. Eby Inc.: Philadelphia, Pa.
72928	Gudeman Co.: Chicago, Ill.
72962	Elastic Stop Nut Corp.: Union,N.J.
72964	Robert M. Hadley Co.: Los Angeles, Calif.
72982	Erie Technological Products, Inc.: Erie, Pa.
73061	Hansen Mfg. Co., Inc.: Princeton, Ind.
73076	H. M. Harper Co.: Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.: Fullerton, Calif.
73293	Hughes Products Division of Hughes Aricraft Co.: Newport Beach, Calif.
73445	Amperex Elect. Co.: Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.: New Haven, Conn.
73559	Carling Electric, Inc.: Hartford, Conn.
73586	Circle F. Mfg. Co.: Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.: Philadelphia, Pa.
73734	Federal Screw Products Inc.: Chicago, Ill.
73743	Fischer Special Mfg. Co.: Cincinnati, Ohio
73793	General Industries Co., The: Elyria, Ohio
73846	Goshen Stamping & Tool Co.: Goshen, Ind.
73899	JFD Electronics Corp.: Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.: San Jose, Calif.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
73957	Groov-Pin Corp.: Ridgefield, N.J.
74276	Signalite Inc.: Nepture, N.J.
74455	J. H. Winns, and Sons: Winchester, Mass.
74861	Industrial Condenser Corp.: Chicago, Ill.
74868	R. F. Products Division of Amphenol-Borg Electronics Corp.: Danbury, Conn.
74970	E. F. Johnson Co.: Waseca, Minn.
75042	International Resistance Co.: Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.: St. Marys, Pa.
75378	CTS Knights Inc.: Sandwich, Ill.
75382	Kulka Electric Corporation: Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.: Chicago, Ill.
75915	Littlefuse, Inc.: Des Plaines, Ill.
76005	Lord Mfg. Co.: Erie, Pa.
76210	C. W. Marwedel: San Francisco, Calif.
76433	General Instrument Corp., Micamold Division: Newark, N.J.
76487	James Millen Mfg. Co., Inc.: Malden, Mass.
76493	J. W. Miller Co.: Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.: San Leandro, Calif.
76545	Mueller Electric Co.: Cleveland, Ohio
76703	National Union: Newark, N.J.
76854	Oak Manufacturing Co.: Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.: N. Hollywood, Calif.
77075	Pacific Metals Co.: San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.: South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.: Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.: Princeton, Ind.
77630	TRW Electronic Components Div.: Camden, N.J.
77638	General Instrument Corp., Rectifier Div.: Brooklyn, N.Y.
77764	Resistance Products Co.: Harrisburg, Pa.
77820	Bendix Corp., Electrical Components Div.: Sidney, N.Y.
77969	Rubbercraft Corp. of Calif.: Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works: Elgin, Ill.
78277	Sigma: S. Braintree, Mass.
78283	Signal Indicator Corp.: New York, N.Y.
78290	Struthers–Dunn Inc.: Pitman, N.J.
78424	Speciality Leather Prod. Co.: Newark, N.J.
78452	Thompson-Bremer & Co.: Chicago, Ill.
78471	Tilley Mfg. Co.: San Francisco, Calif.
78488	Stackpole Carbon Co.: St. Marys, Pa.
78493	Standard Thomson Corp.: Waltham, Mass.
78553	Tinnerman Products, Inc.: Cleveland, Ohio
78790	Transformer Engineers: San Gabriel, Calif.
78947	Ucinite Co.: Newtonville, Mass.
79136	Waldes Kohinoor Inc.: Long Island City, N.Y.
79142	Veeder Root, Inc.: Hartford, Conn.
79251	Wenco Mfg. Co.: Chicago, Ill.
79727	Continental-Wirt Electronics Corp.: Philadelphia, Pa.
79963	Zierick Mfg. Corp.: New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.: Morristown, N.J.
80120	Schnitzer Alloy Products Co.: Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards: Washington, D.C.
80207	Unimax Switch, Div. Maxon Electronics Corp.: Wallingford, Conn.
80223	United Transformer Corp.: New York, N.Y.
80248	Oxford Electric Corp.: Chicago, Ill.
80294	Bourns Inc.: Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.: Columbus, Ohio
80486	All Star Products Inc.: Defiance, Ohio
80509	Avery Label Co.: Monrovia, California
80583	Hammerlund Co., Inc.: Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.: Boston, Mass.
80813	Dimco Gray Co.: Dayton, Ohio
81030	International Instruments Inc.: Orange, Conn.
81073	Grayhill Co.: LaGrange, Ill.
81095	Triad Transformer Corp.: Venice, Calif.
81312	Winchester Elec, Div. Litton Ind., Inc.: Oakville, Conn.
81349	Military Specification
81483	International Rectifier Corp.: El Segundo, Calif.
81541	Airpax Electronics, Inc.: Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.: Watertown, Mass.
82042	Carter Precision Electric Co.: Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.: Hoboken, N.J.
82116	Electric Regulator Corp.: Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.: DuBois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.: Paramus, N.J.
82209	Maguire Industries, Inc.: Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division: Emporium, Pa.
82376	Astron Corp.: East Newark, Harrison, N.J.
82389	Switchcraft, Inc.: Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products: Attleboro, Mass.
82768	Phillips-Advance Control Co.: Joliet, Ill.
82866	Research Products Corp.: Madison, Wis.
82877	Rotron Mfg. Co., Inc.: Woodstock, N.Y.
82893	Vector Electronic Co.: Glendale, Calif.
83003	Varo, Inc.: Garland Texas
83014	Hartwell Corp.: Los Angeles, Calif.
83058	Carr Fastener Co.: Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.: Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.: Darlington, S.C.
83148	ITT Wire and Cable Div.: Los Angeles, Calif.
83186	Victory Eng. Corp.: Springfield, N.J.
83298	Bendix Corp., Red Bank Div.: Red Bank, N.J.
83315	Hubbell Corp.: Mundelein, Ill.
83324	Rosan Inc.: Newport Beach, Calif.
83330	Smith, Herman H., Inc.: Brooklyn, N.Y.
83332	Tech Labs: Palisade's Park, N.J.
83385	Central Screw Co.: Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.: Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.: Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.: New York, N.Y.
83777	Model Eng. and Mfg., Inc.: Huntington, Ind.
83821	Loyd Scruggs Co.: Festus, Mo.
83942	Aeronautical Inst. & Radio Co.: Lodi, N.J.
84171	Arco Electronics Inc.: Great Neck, N.Y.

LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer/Address
84396	A. J. Glesener Co., Inc.: San Francisco, Calif.
84411	TRW Capacitor Div.: Ogallala, Neb.
84970	Sarkes Tarzian, Inc.: Bloomington, Ind.
85454	Boonton Molding Company: Boonton, N.J.
85471	A. B. Boyd Co.: San Francisco, Calif.
85474	R. M. Bracamonte & Co.: San Francisco, Calif.
85660	Koiled Kords, Inc. : Hamden, Conn
85911	Seamless Rubber Co.: Chicago, Ill.
86174	Fafnir Bearing Co.: Los Angeles, Calif.
86197	Cilfton Precision Products Co., Inc.: Clifton Heights, Pa.
86579	Precision Rubber Products Corp.: Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.: Harrison, N.J.
86928	Seastrom Mfg. Co.: Glendale, Calif.
87034	Marco Industries: Anaheim, Calif.
87216	Philco Corporation (Lansdale Division): Lansdale, Pa.
87473	Western Fibrous Glass Products Co.: San Francisco, Calif.
87664	Van Waters & Rogers Inc.: San Francisco, Calif.
87930	Tower Mfg. Corp.: Providence, R.I.
88140	Cutler-Hammer, Inc.: Lincoln, Ill.
88220	Gould-National Batteries, Inc.: St. Paul, Minn.
88698	General Mills, Inc.: Buffalo, N.Y.
89231	Graybar Electric Co.: Oakland, Calif.
89473	G. E. Distributing Corp.: Schenectady, N.Y.
89665	United Transformer Co.: Chicago, Ill.
90030	United Shoe Machinery Corp.: Beverly, Mass.
90179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.: Passaic, N.J.
90970	Bearing Engineering Co.: San Francisco, Calif.
91146	ITT Cannon Elect., Inc., Salen Div.: Salem, Mass.
91260	Connor Spring Mfg. Co.: San Francisco, Calif.
91345	Miller Dial & Nameplate Co.: El Monte, Calif.
91418	Radio Materials Co.: Chicago, Ill.
91506	Augat Inc.: Attleboro, Mass.
91637	Dale Electronics, Inc.: Columbua, Nebr.
91662	Elco Corp.: Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.: Wakefield, Mass.
91827	K. F. Development Co.: Redwood City, Calif.
91886	Malco Mfg. Co., Inc.: Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.: Freeport, Ill.
91961	Nahm-Bros. Spring Co.: Oakland, Calif.
92180	Tru-Connector Corp.: Peabody, Mass.
92367	Elgeet Optical Co. Inc.: Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.: Tarrytown, N.Y.
92702	IMC Magnetics Corp.: Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.: Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.: Woburn, Mass.
93369	Robbins & Myers Inc.: Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.: Mansfield, Ohio
93459	Weinschel Engr. Co., Inc.: Gaithersburg, Md.
93632	Waters Mfg. Co.: Culver City, Calif.
93929	G. V. Controls: Livingston, N.J.
94137	General Cable Corp.: Bayonne, N.J.
94142	Phelps Dodge: Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations: Quincy, Mass.
94148	Scientific Electronics Products, Inc.: Loveland, Colo.
94145	Wagner Elect. Corp., Tung-Sol Div.: Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.: East Paterson, N.J
94222	South Chester Corp.: Chester, Pa.
94330	Wire Cloth Products, Inc.: Bellwood, Ill.
94375	Automatic Metal Products Co.: Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.: Worcester, Mass.
94696	Magnecraft Electric Co.: Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.: Boston, Mass.
95146	Alco Electronic Products Inc.: Lawrance, Ma.
95236	Allies Products Corp.: Dania, Fla.
95238	Continental Connector Corp.: Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.: Long Island, N.Y.
95265	National Coil Co.: Sheridan, Wyo.
95275	Vitramon, Inc.: Bridgeport, Conn.
95348	Gordos Corp.: Bloomfield, N.J.
95354	Methode Mfg. Co.: Rolling Meadows, Ill.
95566	Arnold Engineering Co.: Marengo, Ill.
95712	Dage Electric Co., Inc.: Franklin Ind.
95984	Siemon Mfg. Co.: Wayne, Ill.
95987	Weckesser Co.: Chicago, Ill.
96067	Microwave Assoc., West Inc.: Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.: Olean, N.Y.
96156	Thordarson-Meissner Inc.: Mt. Carmel, Ill.
96296	Solar Manufacturing Co.: Los Angeles, Calif.
96306	Microswitch, Div. of Minn.—Honeywell: Freeport, Ill.
96330	Carlton Screw Co.: Chicago, Ill.
96341	Microwave Associates, Inc.: Burlington, Mass.
96501	Excel Transformer Co.: Oakland, Calif.
96733	San Fernando Elect. Mfg. Co.: San Fernando, Calif.
96881	Thomson Ind. Inc.: Long Is., N.Y.
97464	Industrial Retaining Ring Co.: Irvington, N.J.
97539	Automatic & Precision Mfg.: Englewood, N.J.
97979	Reon Resistor Corp.: Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.: New Rochelle, N.Y.
98144	R-Tronics, Inc.: Jamaica, N.Y.
98159	Rubber Teck, Inc.: Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.: Pasadena, Calif.
98278	Microdot, Inc.: So. Pasadena, Calif.
98291	Sealectro Corp.: Mamaroneck, N.Y.
98376	Zero Mfg. Co.: Burbank, Calif.
98410	Etc. Inc.: Cleveland, Ohio
98731	General Mills Inc., Electronics Div. Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.: Palo Alto, Calif.
98821	North Hills Electronics, Inc.: Glen Cove, N.Y.
98978	International Electronic Research Corp.: Burbank, Calif.
99109	Columbia Technical Corp.: New York, N.Y.
99313	Varian Associates: Palo Alto, Calif.
99378	Atlee Corp.: Winchester, Mass.
99515	Marshall Ind., Capacitor Div.: Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America: El Segundo, Calif.
99800	Delevan Electronics Corp.: East Aurora, N.Y.
99848	Wilco Corporation: Indianapolis, Ind.
99928	Branson Corp.: Whippany, N.J.
99934	Renbrandt, Inc.: Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.: El Monte, Calif.
99957	Technology Instrument Corp. of Calif.: Newbury Park, Calif.

NO SUPPLEMENTS OR ADDENDUMS APPLY TO THIS MANUAL

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